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THE BRYOLOGIST

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STUDIES IN NATURAL HYBRIDIZATION IN THE GENUS *WEISIA*

K. R. KHANNA[1]

Hybridization followed by polyploidy has played one of the major rôles in the evolution of plant species. Unlike the higher plants there have been very few reports of natural hybridization in mosses. Wettstein (1932) has reviewed some such cases. Though extensive and successful studies in artificial hybridization have been carried out in various genera of this group (Allen, 1935, 1945), no case of natural hybridization in mosses has been thoroughly investigated.

The present paper deals with studies in three species of *Weisia*, *W. viridula*, a cosmopolitan species, *W. crispa*, and *W. exserta*, both the latter being the first reports from this country. While collecting the mosses in 1957, the writer was struck by *W. exserta* as a very variable species in nature with regard to the important characters on which species can be based in the genus *Weisia*. This variation was observed to fall in the range of difference between the two well-marked species, *W. viridula* and *W. crispa*, both growing nearby. Specimens were, therefore, picked up as promising material for further studies.

The specimens were sent to Mr. Norkett (London), Drs. Noguchi (Japan) and Chen (China), and except for some nomenclatural differences all were unanimous in their opinion on the above mentioned identification.

THE HABITAT AND DISTRIBUTION OF THE THREE SPECIES

All the species were studied from Pathankot where they grew on a small hill which forms the end of one of the ramifications of the

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Siwalik Range (outer Himalayas) as they enter the plains of Panjab. This hill rises about 500 ft. from the base. It has an approximately northwest-southeasterly direction so that there are distinct north- and south-facing slopes. At many places the top of the hill is a stretch of level ground, and the gradation from one face to the other is quite gradual. At the other places the two faces are connected by various broad or narrow gullies in the body of the hillock.

The northern side because of lesser insolation is very moist, shady, and with thick vegetation. Consequently the forest floor is very moist. The southern slope receiving much higher insolation is dry and xeric. The forest floor on this side is often moist under the trees and shrubs at some places near the top.

The distribution of the three species on the hillock is very interesting and is plotted in Fig. 1 which represents a diagrammatic section through the hillock. *W. crispa* is typical of southern slopes. The insolation is so high and moisture so scant lower down that it is almost impossible for any moss to exist there. It is only near and at the top that this species is found in abundance. Though the southern side with high insolation is the most favoured habitat for *W. crispa,* it occasionally invades the northern side along the line of passes that connect the two sides.

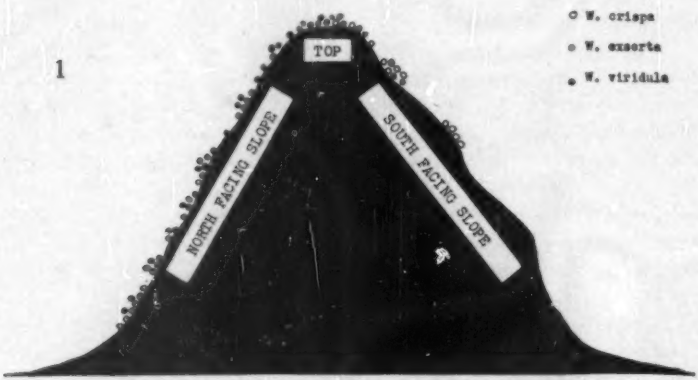

FIG. 1. Diagrammatic section of a hill near Pathankot, showing the distributions of *Weisia crispa, W. exserta,* and *W. viridula.*

W. viridula grows predominantly on the northern slopes. This moss in fact is characteristic of higher altitudes in the Himalayas. It grows at Mussoorie (Mossy Falls) at about 5000 ft. and Baroat (bank of the Uhl River) at about 6000 ft. The latter place is very

near Pathankot, and it appears that this species descends to the lower altitudes from these regions. It grows on the forest floor, over stones, and on the slopes of the mountain side along the paths. Unlike *W. crispa* which occurs occasionally on the north, it is strictly tied to its habitat and is never found on the southern side of the ridge. At the top where conditions of moisture are more favourable than on the dry southern slopes, this moss is often found.

The third species, *W. exserta* is not only widely distributed in this area but also shows an interesting pattern of distribution. It grows very luxuriantly on the north, at the top, and descends to a good extent on the southern side as well. In the latter case, however, it is not able to tolerate as dry habitats as *W. crispa* does. In exceptional cases it was found in small and deep pouches of the southern slope with plenty of moisture even at ground level.

The moisture tolerance in each case can be diagrammatically indicated as follows:

	Dry	Medium	Moist
W. crispa	xxxxxxxxxxxxxxxxxxxxxxxxx		
W. viridula		xxxxxxxxxxxxxxxxxxxxxxxxx	
W. exserta		xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx	

Another fatcor known to have a great influence on the distribution of mosses is the pH value of the substratum. This factor may vary considerably for different substrata in the same locality (Glenn & Welch, 1931). It was thought worthwhile, therefore, to determine whether there existed any differences in pH value of the substrata on which the present species grow. Ten soil samples for each species covering its entire range were taken for comparative pH determination. The pH value of all the substrata studied, varied from 7.5 to 8.75. It follows, therefore, that all three species show a disposition towards slight alkalinity and do not differ from each other in so far as preference for the pH of the substratum is concerned.

Morphological Characteristics

W. crispa (Hedw.) Mitt. Fig. 2. Plants 3-4 cm. high, yellowish to yellowish green. Stems short, erect, sometimes branched. Leaves very lax below but tufted at the top to form a perichaetium, crisped when dry, linear-lanceolate, differentiated into the lower basal region composed of large, rectangular, hyaline cells and the upper region composed of short, quadrate cells with chloroplasts and papillae; margin smooth and strongly involute in the upper region; nerve well developed, excurrent. Perichaetial leaves very

well developed as compared to the lower ones, on the whole much larger, the largest being sometimes 5-6 times as big as the lower, mostly erect, but those at the periphery of the perichaetium mostly horizontal to erect-patent. Seta very short. Capsule globose to subglobose, completely immersed amongst the perichaetial leaves. Calyptra persisting even at maturity in about 75% of cases. Annular cells undifferentiated to feebly differentiated, non-functional. Peristome absent. Lid beak-shaped, not separable from the capsule even on teasing. Dehiscence by irregular breaking of the capsule wall. Spores 30-40 μ (Fig. 14).

The Pathankot population of this species shows some variation with regard to the descriptions given by Dixon (1954) and Chen (1941). Dixon mentioned the spore size to be 14-18 μ, whereas in the present case the spore size is 30-40 μ. Chen described the lid as straight beaked, but here it is predominantly obliquely beaked.

W. viridula [L.] Hedw. Fig. 3. Plants up to 1 cm. high, dark greenish. Stem erect, unbranched. Leaves lax below, tufted above in the region of the perichaetium, strongly crisped when dry, linear-lanceolate from a broad base, much narrower than in *W. crispa*, differentiated into a lower hyaline and an upper photosynthetic region like *W. crispa;* margin strongly involute; nerve excurrent. Perichaetium consisting of leaves of various sizes, slightly larger than the lower ones, horizontal to erect-patent. Seta variable, 4-12 mm. in length. Capsule linear-elliptical. Calyptra falling very early. Annular cells red and thick, well developed. Peristome rudimentary and variable (also see under anatomy). Lid falling off at maturity. Dehiscence regular from the mouth of the capsule. Spores 15-20 μ (Fig. 16).

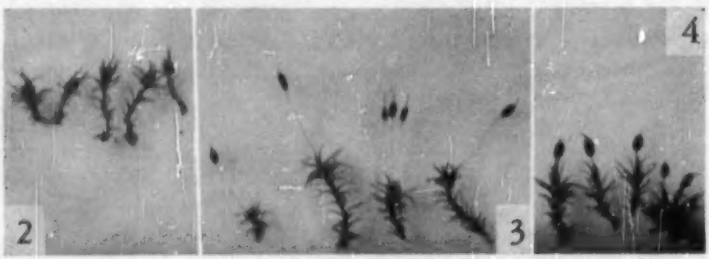

FIG. 2-4. Photographs of species of *Weisia* showing external morphology. 2. *W. crispa*. 3. *W. viridula*. 4. *W. exserta*. × 3.5.

W. exserta (Broth.) Chen. Fig. 4. Plants about 1 cm. high, yellowish to green. Stem erect occasionally branched. Leaves

lax below but crowded at the top to form the perichaetium; those of the perichaetium mostly erect-patent. Shape and characters of the leaf similar to that of *W. crispa*. Length of the seta very variable, from 1 to 4.5 mm. Capsule emerging to well exserted, rarely immersed, elliptical to oval. Calyptra easily falling off. Annular cells well differentiated. Peristome absent, sometimes present in traces (see under anatomy). Lid separating from the capsule on slight pressure, beak-shaped. Dehiscence by the irregular breaking of the capsule wall. Spores very variable in shape and size, 10-30 μ (Fig. 15).

The Pathankot plants of this species show some important differences from the description of Chinese specimens (Chen, 1941). Firstly, in the Chinese material the stem is densely leafy all over, whereas in the present material the leaves in the lower region are very lax and it is only at the perichaetium that they are crowded. Secondly, in the Chinese material the seta is only 1.2 mm. high resulting in an immersed capsule, but here the seta reaches as high as 5 mm., and the capsule is commonly emergent to exserted.

Noteworthy differences were also observed in the material from Japan kindly sent by Dr. Noguchi. In the Japanese material the seta is only up to 2 mm., and the capsule is slightly emergent. Leaves are erect to erect-patent, resembling more nearly those of *W. crispa*. An attempt was made to study the shape and size of the spores, but unfortunately the sporogonia were not mature enough. The Japanese population on the whole is very uniform.

W. exserta as observed during the present study is highly polymorphic at least with regard to the shape of the capsule and the length of the seta. The material of this species from other sources appears to be uniform; the present material differs somewhat in length of seta but conveniently falls within the range of variation for the species. The only difference remaining unexplained is that the Chinese material is thickly leaved throughout, and in this way is different both from the Indian and the Japanese material.

The recent specimens from Pakistan, called *Astomum crispum* var. *exsertum* Nog. (Noguchi, 1956) differ from *Astomum crispum* (= *W. crispa*) in the longer setae making the capsules exserted. An examination of some specimens from Dr. Noguchi showed a great resemblance with some very short plants of *W. exserta* with either immersed or emergent capsules. It is not unlikely, therefore, that this new variety might come under the range of variation exhibited by *W. exserta*. No final statement can, how-

ever, be made until more data on the var. *exsertum* are available, especially cytological.

The comparative account of distinctive morphological characters for the three species is presented in Table I.

TABLE 1. Distinctive morphological characters of three species of Weisia.

	W. crispa	*W. exserta*	*W. viridula*
Shape of leaves.	Broad, lanceolate.	Broad, lanceolate.	Narrow, lanceolate.
Differentiation of perichaetial leaves.	Very well marked.	Intermediate between *W. crispa* and *W. viridula*.	Somewhat larger than lower ones but differentiation not well marked.
Direction of majority of perichaetial leaves.	Erect.	Erect-patent to erect.	Horizontal to erect-patent.
Length of seta and position of capsule.	Up to 0.8 mm.; completely immersed.	1.0-4.5 mm.; immersed to exserted.	4-12 mm.; well exserted.
Shape of capsule.	Globular to subglobular.	Oval.	Linear-elliptical.
Annular cells.	Feebly differentiated, taking no part in dehiscence.	Well developed but taking no part in dehiscence.	Well developed, taking part in dehiscence.
Peristome.	Completely absent.	Absent. Observable in some cases on sectioning capsule.	Present but not well developed.
Position of calyptra at maturity.	Not falling in about 80% of cases.	Sticks in some cases.	Always falling.
Spore size.	30-40 μ.	10-30 μ.	15-20 μ.

PICTORIALIZED SCATTER DIAGRAM

The statistical range of variation of each species and their relationship to one another for certain measurable characters are provided by a pictorialized scatter diagram (Fig. 5), after the technique described by Anderson (1949).

Thirty two plants were taken for comparison with respect to the following four characters: (1) The length of foot and seta represented along the horizontal axis. (2) The length of the capsule represented along the vertical axis. (Both characters are correlated and are plotted against each other in small circles. Each circle represents an individual plant. The characters are easy to score and were measured with a micrometer under the binocular.)

(3) The breadth of the capsule also measured under the binocular is represented by the length of the rod at the right top of each circle. (4) The angle of the perichaetial leaves with the stem is a very variable, but the majority have the same direction and the average can be made out. This character is rather difficult to score and its representation in the diagram is more or less approximate. It is represented by the angle of the rod on the left top of each circle.

In all the characters *W. exserta* falls in a more or less intermediate position. The breadth of its capsule is sometimes much greater than in either of the other species. This probably is an attempt towards scoring a globular shape for the capsule which is somewhat characteristic of *W. crispa* which as pointed out below is one of its probable parents.

Anatomical Characteristics

The basic pattern of vegetative anatomy in all three species is very similar, and hence anatomical study brought out no distinguishing characters. A comparative study of the peristome in the three cases, however, proved to be very interesting. The peristome is very variable in *W. viridula*. Material of this species collected by G. Foreau from Palni Hills (S. India) showed the complete lack of peristome, whereas the material from Mussoorie showed a well-developed peristome consisting of 16 regular teeth. There was observed a considerable variation in the present material originating even from the same locality, Pathankot. Some plants had 16 well-developed teeth; in the others the number of teeth was variable. In Fig. 6 is shown a cross-section of the upper region of the capsule where the peristome is entirely lacking on one side. Peristome teeth were often perforated or irregularly lobed. In *W. exserta* no peristome is visible on removing the lid and usually cannot be traced even on sectioning the capsule. Rarely, irregular, slight thickenings are found on the walls of the cells (Fig. 7) which normally are destined to give rise to the peristome. These evidently are the traces of an undeveloped peristome. In *W. crispa* no peristome was found at all.

Cytological Characteristics

W. crispa: The chromosome number as studied from a number of spore mother cells was found to be 13 (Fig. 8). One of the bivalents is almost twice as big as the others and usually disjoins precociously into homomorphic partners. An interesting feature of some members of the population is the presence of an additional small bivalent making the chromosome number $n = 14$ (Fig. 9). This bivalent is also precocious in disjunction and when not dis-

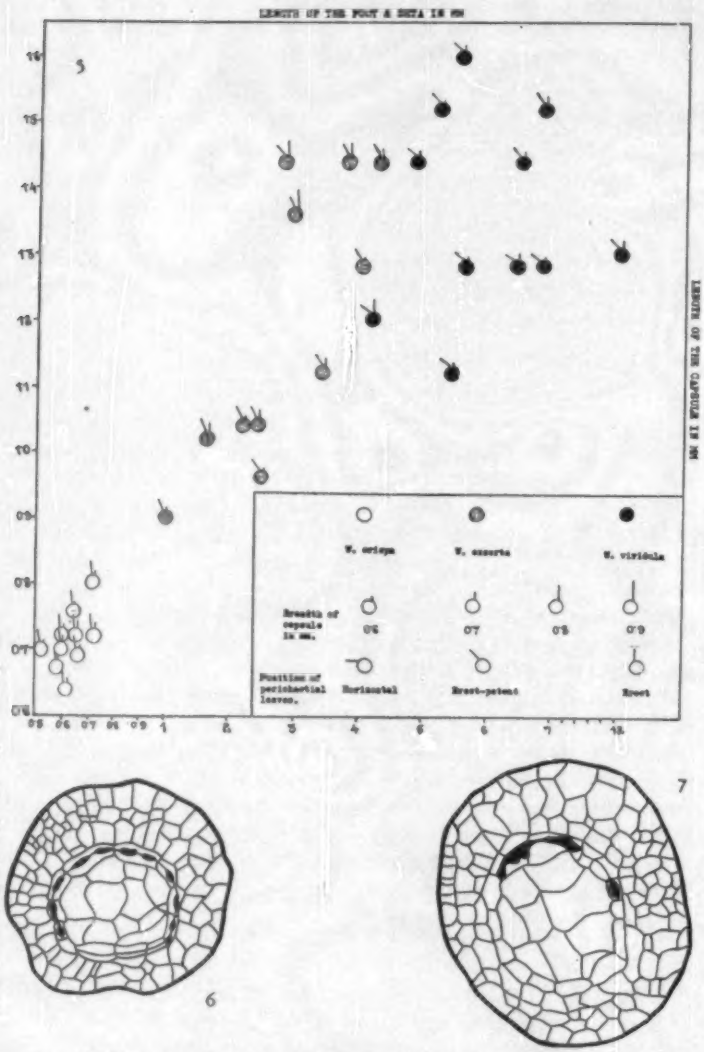

FIG. 5. Pictorialized scatter diagram showing length of foot and seta, length of capsule, breadth of capsule, and the angle of the majority of perichaetial leaves in three species of *Weisia*. FIG. 6-7. Cross-section through the peristome region of capsules. 6. *Weisia viridula;* note complete lack of peristome on lower side. 7. *W. exserta;* the peristome is imperfectly developed in traces. × 400.

joined can hardly be distinguished from other bivalents. Its presence or absence was found to have no effect on the morphology and vigour of the plants. It could not be decided whether this minute bivalent is of recent origin or is a normal bivalent in a state of degeneration. The course of meiosis is regular in both cases so that normal tetrads are organized. This species has been recently worked out from Japan (Sannomiya, 1958) under the name *Astomum crispum*; this report also shows n = 13.

W. viridula: Here too, 13 bivalents were observed (Fig. 10). Like *W. crispa* there is a large bivalent whose partners do not show any morphological dissimilarity. In this species the minute bivalent so characteristic of some of the members of *W. crispa* was not observed. The course of meiosis is perfectly regular. The present count is in accord with previous reports for this species (Steere *et al.*, 1954; Bryan, 1956, etc.).

W. exserta: The species, though morphologically highly variable as mentioned earlier, is cytologically very uniform and possesses the chromosome number n = 26 (Figs. 11, 12). This includes two large bivalents that are precocious in disjunction. One of the two large bivalents is distinctly more precocious than the other (Fig. 12). This number is at a diploid level.[2] The differential behaviour of the two large bivalents may point towards the allodiploid nature of the species. This species has been worked out cytologically for the first time.

The course of meiosis is normal, there being no multivalent formation or any other irregularities. Four equal-sized nuclei are organized at the end of meiosis. The wall formation is of a simultaneous type but irregular. This results in tetrads and polyads. The tetrads are of two types: Those in which there is an equal distribution of cytoplasm around each of the four nuclei, resulting in cells of an equal size, and those in which there is an unequal distribution of cytoplasm, resulting in four cells very variable in size. In the case of polyads the cytoplasm is divided up into a number of irregular bits which may number up to 8 or 9 but only 4 of them contain nuclei (Fig. 13). So from a single mother cell there result four apparently viable, well-filled spores, though variable in shape and size, and in addition a number of enucleate spores that must degenerate.

This clearly indicates that nuclear division and cytokinesis are

[2] In bryophytes it is the haploid phase that is dominant in the life cycle, as opposed to higher plants where the dominant phase is diploid. So normally an individual termed haploid would be comparable to the diploid of the higher plants. Similarly a diploid is comparable to a tetraploid.

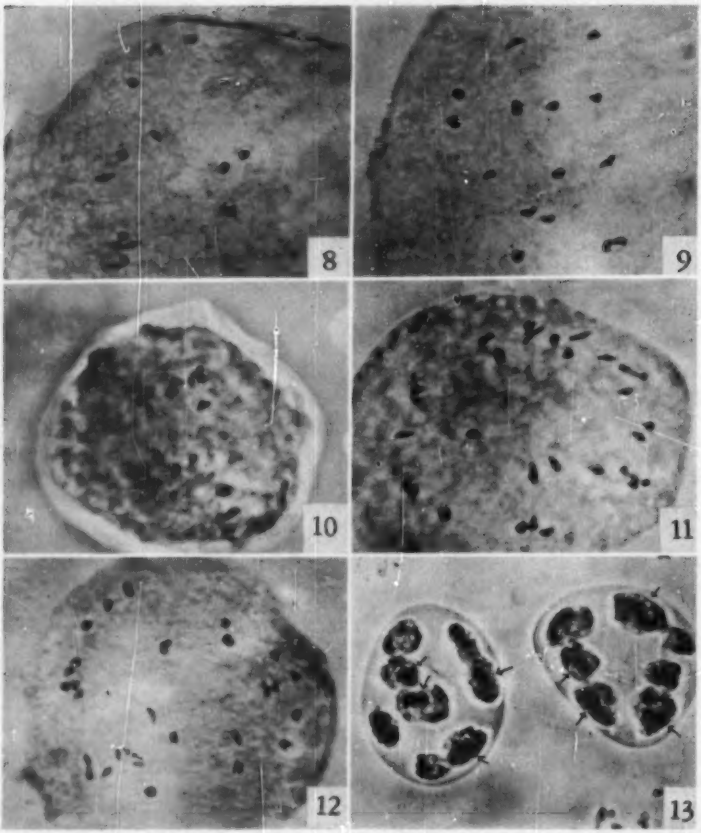

FIG. 8-12. Meiotic bivalents at MI. 8. *Weisia crispa*, n = 13. 9. *W. crispa*, n = 14. 10. *W. viridula*, n = 13. 11-12. *W. exserta*, n = 26. (Note the large, rod-shaped bivalent in *W. crispa* and *W. viridula* and two such bivalents in *W. exserta*.) In fig. 12 one such bivalent is precociously disjoining; the disjoined partners are marked with arrows. × 2100. FIG. 13. Polyads in *W. exserta*, only four (marked by arrows) with nuclei. × 1050.

very distinct processes which though normally co-ordinated are governed by different factors. It also shows that this diploid species may originate from two different genomes. Since each genome is represented by the two sets of chromosomes in the sporophyte there is no difficulty in pairing during meiosis, a feature characteristic of the allotetraploids (a comparable terminology for higher plants). But the forces exercised by the two genomes on

cytokinesis must be disharmonious, resulting in unequal tetrads and polyads. The situation is further clarified on comparing the spore size, 10-30 μ (Fig. 15), with that of *W. crispa*, 30-40 μ (Fig. 14), and *W. viridula*, 15-20 μ (Fig. 16) which are its probable parents. The above abnormalities of shape and size result from the attempt by the hybrid to strike an intermediacy in spore size.

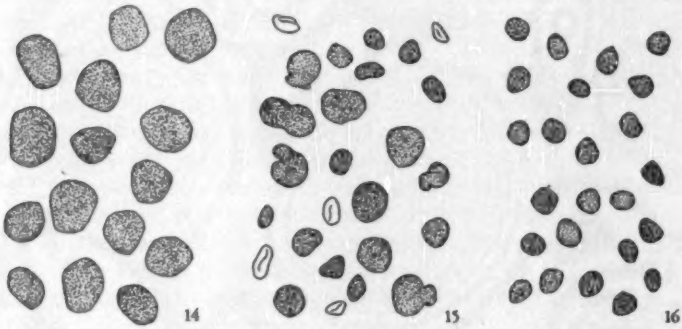

FIG. 14-16. Spore characteristics. 14. *W. crispa*. 15. *W. exserta*. 16. *W. viridula*. × 800.

THE FRUITING SEASON

It is well known that the time of bearing of sporogonia in mosses is greatly influenced by the availability of moisture. This causes considerable fluctuation in the time of fruiting in the present species as well. However, the three species do show a marked difference amongst themselves with regard to this character. All of them are winter-fruiting. Earliest to fruit is *W. crispa*, the species of the southern slopes. It starts fruiting in the third week of October and is almost mature by the end of November. The fruiting season of *W. viridula* varies a good deal. Though it fruits very well by the end of November at higher altitudes (Baroat, 6000 ft.), it does not fruit vigorously at Pathankot till the end of December and the beginning of January. By then the temperature goes down considerably, and there may be a few showers. The capsules are mostly ripe by the end of January. *W. exserta* shows a wide range in fruiting season corresponding with its variable habitat. One can find its sporogonia in all stages from the second week of November to the end of January.

THE AMPHIDIPLOID ORIGIN OF W. EXSERTA

A perusal of the previous morphological accounts of *W. crispa* and *W. viridula* on one hand and of *W. exserta* on the other

highly suggests that the latter is an intermediate type. A comparison of the important differentiating characters given in Table I clearly shows that *W. exserta* tends more towards one parent in some respects and towards the second in others. For instance, it tends more towards *W. crispa* in the shape and arrangement of the leaves on the stem, the lack of a peristome, and an almost functionless annulus and towards *W. viridula* in the length of the seta, the shape and length of the capsule, and fall of calyptra at maturity. It is almost intermediate in the direction of the perichaetial leaves and the emerging nature of the capsule in some cases. The lack of a peristome in the amphidiploid *W. exserta*, contrasting with its presence in one of its parents, *W. viridula*, shows that the gene for "non-peristomate" type, is perhaps dominant over the "peristomate" one. And as both genomes are always present together in *W. exserta*, the "peristomate" gene might have little chance of expression. Further, the peristome of *W. viridula* observed in various stages of imperfect development might be an indication that the peristomate gene here is already in a state of degeneration. There is hardly any character in *W. exserta* known to the writer which cannot be explained on the basis of the morphology of the two parents. The pictorialized scatter diagram well represents the intermediate position of *W. exserta* with regard to a number of characters on a statistical basis. The anatomical characters of the vegetative organs are common to all three species and are thus of little value in drawing relationships. Further support for this hypothesis comes from the study of the chromosome number of all three species. *W. viridula* and *W. crispa* have 13 bivalents each, but *W. exserta* has 26, two of which are large and show differential behaviour at disjunction. This together with the abnormal cytokinesis having its basis in the widely different spore size in the parents goes to show the allodiploid nature of *W. exserta*. Further, it grows in the entire range of habitat of the two parents (though *W. crispa* can tolerate a more xeric climate) which themselves are more or less secluded from each other and covers almost the entire range of the fruiting season of the two. All this provides strong circumstantial evidence of the amphidiploid nature of *W. exserta* with *W. viridula* and *W. crispa* as its putative parents. The unequivocal proof for this would come only when *W. exserta* is artificially synthesized and is crossed with wild *W. exserta* to produce a fertile progeny.

Whereas the amphidiploid origin for many species is an established fact in flowering plants, no previous account of this type exists for mosses. Even the reports of hybridization in nature for

mosses are too few. *Weisia*, however, is one of those genera in which natural hybridization has been known. Hybridization is reported in the following, all from England (Nicholson, 1905, 1906, 1910; vide Wettstein, 1925): 1. *W. crispa* × *W. microstoma*. 2. *W. crispa* × *W. crispata*. 3. *Trichostomum flavovirens* × *W. crispa*. In each case one of the present species, *W. crispa* is involved, and in the first two cases the other species are quite closely related to *W. viridula*. *W. microstoma* is almost exactly like *W. viridula* except for peristome differences (present in *W. viridula* and entirely absent in *W. microstoma*, according to Dixon, 1954). *W. crispata* too is very close to *W. viridula* so that some plants actually belonging to this species were referred to *W. viridula* var. *gymnostomoides* by Dixon (*l.c.*). These reports of hybridization between *W. crispa* and the species closely allied to *W. viridula* show a similarity to the present situation. It is likely that many more instances of hybridization within the genus *Weisia* are still to be discovered, and many overlapping and less clearly differentiable species may be owing their origin to this phenomenon.

The Mechanisms of Isolation

The main isolating factor between *W. crispa* and *W. viridula* is the difference in their habitats. Whereas *W. crispa* grows on the dry xeric southern slopes, *W. viridula* is confined only to the northern slopes with plenty of moisture. The intermediate habitats are to be found at the hill tops where there is dense shade and at the places where the two faces are connected with each other through a narrow or broad gully. It is only at these places that both of them are sometimes found together. Now, in view of the fact that the amphidiploid species, *W. exserta* is spread all over, including these habitats, it must have first originated at these intermediate habitats where the parents might have had a chance to hybridize.

Another factor separating the two parents is their fruiting season. In this locality *W. viridula* begins fruiting when *W. crispa* almosts ends. Though the two might be fruiting simultaneously, it is doubtful that the time of fertilization synchronizes. The occasional abnormal season of excessive rains which prolongs the fruiting season in mosses might well be responsible for overlapping of the fruiting time, and that may promote hybridization.

Apart from the above mechanisms of isolation there must be a strong, though not perfect genetic isolation between the parents. The two species quite often grow side by side, at least in the intermediate habitats, and it is also possible sometimes to find them at a similar stage of development as regards fruiting. But in spite of

a thorough search no F_1 hybrids with $n = 13$ could be found at such habitats. It means, therefore, that the haploid hybrid must occur very rarely and when arising must be eliminated by natural selection. Only those hybrids which duplicated their chromosome set would have formed the successful amphidiploid species *W. exserta* which is widely spread today in these habitats.

Such a rôle of amphidiploidy in the evolution of plant species has been experimentally demonstrated by a number of workers, particularly Clausen, Keck, & Hiesey (1945). This was done by the artificial synthesis of *Madia nutrammii* which is believed by these authors to be a good species. *Madia nutrammii* ($n = 17$) arose through hybridization between *M. nutans* ($n = 9$) and *M. rammii* ($n = 8$). It was observed that the F_1 generation shows high sterility, but after a number of generations good fertility and balance in the population is achieved through amphidiploidy. During this period plants with unstable chromosome numbers are eliminated by natural selection. Similar gradual stabilization of the hybrid population by restoring to amphidiploidy in the following generations has been described by these authors (*l.c.*) to take place in *M. citrigracilis* and *Layia pentaglossa*. The literature on the subject is extensive and has been reviewed by these authors and by Stebbins (1950).

W. exserta as a Distinct and Vigorous Species

W. exserta merits the rank of a perfect species. It is morphologically very distinct from the parents and has a variation pattern of its own. Since it is at a diploid level, the gene exchange with either parent is completely absent. As a great variation is observed in the field, this species appears to be very young and segregating. It is vigorous because it combines the capacities of both parents regarding habitat preference and fruiting season. It is robust and luxuriant in growth. The capacity of a hybrid species to have a range of distribution wider than either of the parents is known in other cases as well: *Phleum pratense* (Gregor & Sansome, 1930, Gregor, 1931); *Poa annua* (Nannfeldt, 1937); *Rumex acetosella* (Löve, 1941, etc.).

A comparative study of present material of *W. exserta* and that described as such from other countries showed some differences pointed out above. There may or may not exist any true relationship between the present *W. exserta* and that coming from other sources, and the morphological resemblances amongst them may only be spurious. A thorough investigation of *W. exserta*

from these localities with particular reference to the distribution of *W. viridula* and *W. crispa* is therefore necessary.

Bearings of This Work on Classification and Relationships in the Genus

The cleistocarpous species of *Weisia* to which *W. crispa* belongs have been grouped in a different section of the genus, Systegium, in contrast to Euweisia and Eucladium to which the peristomate species belong (Dixon, 1954). Some other workers maintain an entirely different genus, *Astomum*, for the cleistocarpous *Weisiae* (Brotherus, 1924; Noguchi, 1956, 1958, and a number of others).

Hilpert (1933) was the first to suggest merging the two genera. Chen (1941) followed him in his monograph on East Asian Pottiaceae. The two genera are indistinguishable vegetatively, and the important difference between them is the cleistocarpous nature of the capsule in *Astomum*, with the presence of a peristome in *Weisia*. This is not an important difference because as Chen (personal communication) pointed out, "It is a common phenomenon of reduction (stegocarpic to cleistocarpic) in evolutionary tendency in different moss families. Intermediate forms between the cleistocarpic and stegocarpic capsules are usually being observed."

The possibility of hybridization (*W. crispa*, being cleistocarpous, and *W. viridula* stegocarpous) as brought out during the present study and similar cases of hybridization referred to above show that the relationship is close and natural. Further, the two are connected by transitional types in sporophytic characters as described for *W. exserta*. This shows the arbitrariness of classification of the two as separate genera and supports the conclusion of the latter authors who have merged them. For the sake of taxonomic convenience it may be desirable to maintain Dixon's classification of *Weisia* in sections Systegium, Euweisia and Eucladium.

Summary

By a comparative study of habitat, morphology, anatomy, cytology, and fruiting season of three species of the genus *Weisia, i.e. W. crispa, W. viridula* and *W. exserta*, it has been found that *W. exserta* is an intermediate type, all its characters ranging between *W. crispa* and *W. viridula*. On these bases, *W. exserta* is suggested to be an amphidiploid between *W. crispa* and *W. viridula*. It possesses all the merits of a young and vigorous species. The mechanisms of isolation between the parental species and the bearings of the present work on the classification and relationships within the genus *Weisia* are discussed.

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CHROMOSOME NUMBERS OF SOME ARIZONA MOSSES[1]

MATTI AL-AISH[2] and LEWIS E. ANDERSON[3]

Chromosome studies of mosses in North America have been confined largely to species found in mesic or near-mesic situations. Previous studies have included moss populations from central and northern California (Steere, Anderson & Bryan, 1954; Vaarama, 1953), Alaska (Steere, 1954), Canadian Rocky Mountains (Anderson & Crum, 1959), and, in the eastern United States from Florida to Nova Scotia and as far west as Michigan (Anderson & Bryan, 1956, 1958; Bryan, 1955, 1956a, 1956b, 1957; Lowry, 1948, 1953, 1954a, 1954b). No studies of chromosomes have been made of species from the more xeric regions of the Southwest. Steere, Anderson and Bryan (1954) studied a few species from the drier slopes of the Sierra Nevada in California, and Anderson and Crum (1959) investigated the chromosomes of some mosses from the drier eastern slope of the Canadian Rockies, but the remaining studies have dealt mainly with species from more moist habitats. Through the kindness of Mrs. Ardith Brask Johnsen, who is conducting floristic and ecological studies of the bryophytes of Oak Creek Canyon, in northwestern Arizona, we received a shipment of mosses from this area with sporophytes in suitable condition for meiotic studies. We were able to establish chromosome counts for six species, two of which have not previously been studied.

The methods of shipping, receiving, and storing material at low temperatures have been described in detail by Anderson and Crum (1959). These methods were followed faithfully in the present study, as were fixing and staining procedures. All material was studied by means of squash techniques using young capsules from which sporocytes were squeezed out in Carnoy's fixative (3:1) and stained, squashed, and studied in acetic orcein, as described in detail by Steere, Anderson and Bryan (1954). The results are presented and discussed under the heading of each species. All specimens were collected in Oak Creek Canyon, altitude 5500 ft., Coconino Co., Arizona, by Ardith Brask John-

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sen, May 1959. A complete set of voucher specimens have been deposited in the herbarium of Duke University.

Bryum capillare Hedw.
n = 20 (Fig. 1-2)

This is the second population of this widespread species to be studied in North America. Steere, Anderson and Bryan (1954) studied a California population which had a haploid number of 11 (10 + 1). The same species in Europe was reported to have the number, n = 10 (Marchal & Marchal, 1911) and n = 9-10 (Heitz, 1928). The Marchals were able to produce a tetraploid race of this species by experimental means in which the chromosome number was n = 20, which they called "var. *bivalens*." The chromosome number, n = 20, found in the Arizona plants, therefore, is not unexpected, although this is the first natural population of *B. capillare* in which a polyploid number has been observed. Metaphase 1 figures clearly show 20 bivalents (fig. 1, 2). Steere, Anderson and Bryan (1954) reported two small chromosomes (forming a small bivalent which disjoined precociously) in addition to the complement of 10 large bivalents. They also noticed a tendency for these 10 bivalents to become associated into five groups of two bivalents each, a phenomenon not noted in the Arizona plants studied here. Also, we did not observe diminutive chromosomes such as were reported in the California populations by Steere, Anderson and Bryan.

Multivalents, secondary association, stickiness of chromosomes, and chromatin bridges were not observed in Arizona material, or lagging chromosomes.

Polyploid species are not unusual in *Bryum*, as perhaps might be anticipated on the basis of the ease with which experimental polyploids have been produced within the genus (Marchal & Marchal, 1911; Wettstein, 1937). The tetraploid number, n = 20 has been reported in *B. arcticum* (R. Br.) BSG and *B. nitidulum* Lindb., both arctic species, by Steere (1954) and in *B. pseudotriquetrum* (Hedw.) Schwaegr. by Anderson and Crum (1959), and larger polyploid numbers were found by Steere (1954) in *B. inclinatum* (Web. & Mohr) Sturm. (n = 30), *B. calophyllum* R. Br. (n = 40) and in an unidentified species (n = 50). Since previous polyploid reports in *Bryum* have been based on arctic or extreme north temperate populations, it is significant to find a polyploid population as far south as Arizona.

Bryum gemmiparum DeNot.
n = 20 (Fig. 3-4)

No previous chromosome counts have been made of this species, which, according to Andrews (1935), has been confused with *B. muhlenbeckii* BSG. Chromosomes of the latter species also have not been investigated. The chromosome complement of *B. gemmiparum* agrees closely in number and morphology with that of *B. capillare*. No diminutive chromosomes were observed, and behavior of chromosomes at Metaphase I appeared to be normal. No multivalents, excessive lagging of chromosomes, chromatin bridges, or other cytological evidences of polyploidy were observed.

The absence of small, precociously dividing bivalents in both species of *Bryum* studied from Arizona is in line with observations that have been made on other polyploid species and races of this troublesome genus. Steere, Anderson, and Bryan (1954) observed small bivalents in a diploid population of *B. pseudotriquetrum* from California, but a tetraploid population from the Canadian Rockies was found by Anderson and Crum (1959) not to contain the small chromosomes. In spite of the apparent ease with which experimental autopolyploids have been produced in mosses there is still little or no cytological evidence that natural polyploids are formed in this manner. Anderson and Bryan (1956) concluded from a study of chromosome morphology that a tetraploid species, *Fissidens adiantoides* Hedw., could not have arisen through doubling of the chromosome complement of the other member of the closely related species-pair, *Fissidens cristatus* Wils.

Leptobryum pyriforme (Hedw.) Schimp.
$n = 24$ (20 + 4) (Fig. 5-7)

This is the third population of this cosmopolitan species to be investigated. Anderson and Crum (1959) reported the number, $n = 20$, in two populations from the Canadian Rockies, but did not observe in either population any small precociously separating bivalents as were seen in the complement of the Arizona plants. In many species of mosses the diminutive chromosomes stain less vividly and are often difficult to observe, so it is not improbable that they could have been overlooked in the Canadian material. It seems more likely, however, that the Arizona population represents a distinct chromosome race. Several such races possessing additional small chromosomes are already known in the Bryaceae. Vaarama (1956) reported a population of *Bryum caespiticium* Hedw. from the British Isles with an additional small chromosome (10 + 1), and races with extra small chromosomes are known in *B. capillare* (Steere, 1954), *B. pseudotriquetrum* (Steere, Anderson & Bryan, 1954), and *B. turbinatum* (Hedw.) Schwaegr.

(Anderson & Crum, 1959). Two races of *Pohlia cruda* (Hedw.) Lindb. have been discovered in the Canadian Rockies (Anderson & Crum, 1959) with widely differing chromosome numbers, one (from Banff National Park) with the high polyploid number, n = 40, while another from Yoho National Park was found to have the number, n = 10 + 4. No significant morphological differences between the two races were reported.

Orthotrichum rupestre Schleich.
n = 12 (Fig. 8-11)

Two previous studies (Steere, Anderson & Bryan, 1954; Anderson & Crum, 1959) of the chromosome number of this widely distributed western species have both reported a haploid number of 6. Of the many species of *Orthotrichum* whose chromosome numbers are known, those with superficial stomata have consistently been found to have the number n = 6, while, with the startling exception of *O. jamesianum,* which has the number n = 18 (Anderson & Crum, 1959), those with immersed stomata have been found to have the number n = 11. The present report of a haploid number of 12 for *O. rupestre* is the first instance of polyploidy that has been found in the group of species with superficial stomata. The Arizona plants from which the present count was established have been carefully compared with plants from diploid populations in both California and the Canadian Rockies, but no differences can be found among them. The Arizona plants are, if anything, less robust than average, the spores are approximately the same size as those from California and the Rockies, and the spore mother cells, which often in tetraploid mosses are larger, appear also to be normal in size.

The peristome teeth of the Arizona plants are finely and lightly papillose as are most of the specimens from the southwestern U. S. in the Duke herbarium. The capsules are slightly emergent, but there can be no question about the identity of the plants from which the counts were made.

Haplocladium microphyllum (Hedw.) Broth.
n = 11 (Fig. 12-13)

Eleven bivalents were observed at first metaphase in numerous preparations of sporocytes of this species. This count differs from a previous report by Sannomiya (1958), who found only 10 bivalents in first metaphase figures of Japanese populations. We have also observed the number, n = 11, in two populations of *H. microphyllum* from Florida (Al-Aish & Anderson, unpublished),

and so there seems to be no question concerning the presence of 11 bivalents in American material. Ten relatively large bivalents and a smaller bivalent that is scarcely small enough to be described as a diminutive were observed in all sporocytes studied (fig. 12-13). In fig. 12, the small bivalent is in about the 7 o'clock position, while in fig. 13 the small bivalent can be seen at approximately the 1 o'clock position. During MI, the small bivalent disjoins precociously, but the bivalent and the resulting half-bivalents stain as intensely with acetic orcein as the larger bivalents.

Two Japanese species of *Haplocladium*, *H. subulaceum* (Mitt.) Broth. and *H. subulatum* Card., have been studied cytologically by Yano (1957a). In *H. subulaceum*, a monoicous species, Yano found the number, n = 10, but in *H. subulatum*, which apparently may be monoicous or dioicus, Yano (1950) reported the number, n = 8, in male gametophytic plants, but found a haploid number of 10 in a monoicous plant (1957a) a count that Yano later (1957b) confirmed in monoicous plants from still another population. Yano's counts on *Haplocladium* are all based on somatic chromosomes observed in gametophytic tissues, and raise the question as to whether or not the small precociously dividing bivalents can be demonstrated in somatic cells. Bryan (1955) was unable to detect diminutive chromosomes in dividing cells of the gametophyte of *Sphagnum* although in sporophytes arising from the same plants she could demonstrate the tiny bivalents at meiosis. Sannomiya (1958), however, established the number, n = 10, in meiotic divisions of both *Haplocadium subulaceum* and *H. microphyllum*. It seems likely, therefore, that there are different chromosome races on the two continents.

In this connection it might be pointed out that a similar situation exists in the genus *Thuidium*, as regards Japanese and American chromosome numbers. All the species of *Thuidium* that have been investigated cytologically in Japan have the number, n = 10, while all the American species have the number, n = 11 (see Anderson & Bryan, 1958).

Campylium hispidulum (Brid.) Mitt.
n = 14 (Fig. 14)

This is the first report of the chromosome number for this common element of the moss flora of the eastern U. S. Thirteen large bivalents and one small precociously separating bivalent were observed during meiosis. In fig. 14, a polar metaphase view, the small bivalent already separated and the two half bivalents are shown some distance apart. Good figures were difficult to obtain

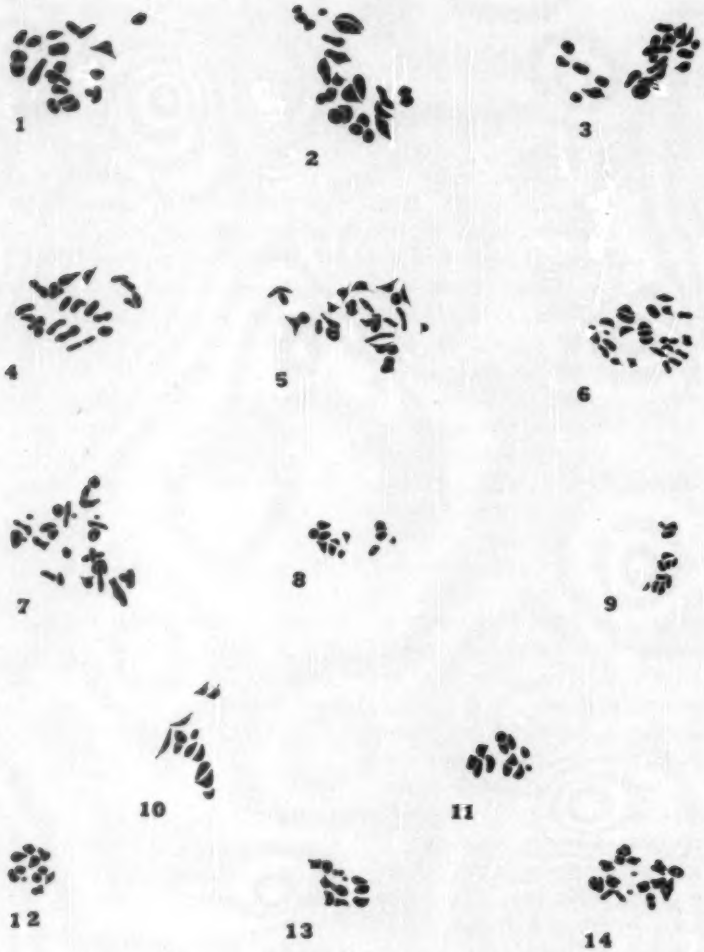

FIG. 1-2. *Bryum capillare* (n = 20). 1. Polar view of MI showing 20 bivalents. 2. Later stage showing 19 bivalents and 2 half-bivalents.—FIG. 3-4. *Bryum gemmiparum* (n = 20). 3. Polar view of MI showing 20 bivalents. 4. MI, polar view showing 20 bivalents, one about to disjoin.—FIG. 5-7. *Leptobryum pyriforme* (n = 24). 5. 24 intact bivalents in polar view of MI. 6. Polar view of MI with 23 bivalents and 2 half-bivalents. 7. Polar view of MI with 22 bivalents and 4 half-bivalents.—FIG. 8-11. *Orthotrichum rupestre* (n = 12), all figures showing 12 bivalents at MI (fig. 8 and 11, polar views; fig. 9 and 10, side views). FIG. 12-13. *Haplocladium microphyllum* (n = 11), polar views of MI with 10 large bivalents and 1 small

in the material studied, for the chromosomes are somewhat sticky and difficult to spread apart. Also, meiosis occurs before the original cell wall of the spore mother cell dissolves, making it necessary to dissect out the sporogenous tissue from the capsule. However, enough satisfactory figures were obtained to establish the number of chromosomes without question.

Andrews (1957) has recently written a very penetrating article dealing with the genus *Campylium*, which traditionally has been placed in the Amblystegiaceae. Grout (1931) used the genus *Campylium* in a very broad sense and included in it some nine species of doubtful relationship, including *C. hispidulum*, *C. halleri* (Hedw.) Lindb., *C. stellatum* (Hedw.) Lange & C. Jens., *C. chrysophyllum* (Brid.) Bryhn, *C. polygamum* (BSG) Bryhn, and *C. radicale* (P. Beauv.) Grout. Andrews, supporting earlier notions by Mitten (1869) and Lindberg (1879), suggested that *Campylium* should include only *C. halleri* and *C. hispidulum*, as well as *C. lacerulum* (Mitt.) Broth., a Himalayan species, and that in this sense *Campylium* belongs in the Hypnaceae (*sensu stricto*). Andrews suggested that *C. chrysophyllum*, *C. stellatum*, and related species should then be excluded from *Campylium* but left in the Amblystegiaceae. This is undoubtedly a stand that many bryologists will look upon with favor, for there are sound taxonomic reasons which Andrews has enumerated to support it.

Cytological evidence bearing on the problem remains inconclusive. Three separate studies of the chromosomes of *C. stellatum* have yielded three different counts. Heitz (1928) reported the haploid number as 6-8, Steere (1954), working with Alaskan material, found the number, $n = 22$, while Anderson and Crum (1959), studying a population from the Canadian Rockies, reported a haploid number of 20, comprising 18 large bivalents and 2 small bivalents (18 + 2). Yano (1950) studied somatic chromosomes in the gametophytes of *C. chrysophyllum* and found the n-number to be 9. In the family Amblystegiaceae, the numbers, $n = 10$ and $n = 12$, are the most commonly encountered, but the numbers, $n = 12$, 13, 19, and 22, have also been reported. In the Hypnaceae (*sensu stricto*), of the species whose chromosome numbers are known, the number, $n = 11$, is by far the most prevalent, although the numbers $n = 6$, 7, 10, 14, 16, 20, and 22 have also been reported within the family. Some of the discrepancies in reported chromosome numbers undoubtedly result

bivalent; note one large bivalent about to disjoin in fig. 13.—FIG. 14. *Campylium hispidulum* ($n = 14$), polar view of late MI showing 13 bivalents about to disjoin and 2 half-bivalents. (*All figures* × 1450.)

from the failure to observe the diminutive bivalents, which apparently do not exist in some populations, or else they stain faintly, or because of small size and similar staining qualities are confused with cytoplasmic inclusions. Some of the apparent differences in chromosome numbers recorded by different investigators for the same species can be explained by the fact that a large number of moss species are still very poorly understood, taxonomically, so that different investigators actually may not be dealing with the same species. On the other hand, some of the differences in numbers unquestionably represent intraspecific chromosome races. There is great need for further refinements of cytological techniques. Careful studies of meiotic behavior, especially regarding the behavior of the diminutive chromosomes, should be carried out on many populations of each species from widely separated populations. This information will have to be combined and knowledgeably integrated with thorough taxonomic studies before the complex relationships of these species can be understood.

TABLE 1. Chromosome numbers in six species of Arizona Musci, which were collected by Ardith Brask Johnsen, two miles in Oak Creek Canyon, altitude of 5500 ft., Coconino Co., Arizona.

Species	Reference Number	Chromosome Number	Figures
Bryum capillare Hedw.	763	n = 20	1, 2
Bryum gemmiparum DeNot.	780	n = 20	3, 4
Leptobryum pyriforme (Hedw.) Schimp.	781	n = 24	5, 6, 7
Orthotrichum rupestre Schleich.	782	n = 12	8, 9, 10, 11
Haplocladium microphyllum (Hedw.) Broth.	783	n = 11	12, 13
Campylium hispidulum (Brid.) Mitt.	784	n = 14	14

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THE CHROMOSOMES OF BARTRAMIDULA CAROLINAE

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Although the Bartramiaceae have received considerable attention cytologically, the chromosomes of *Bartramidula* BSG have not been studied. The genus comprises a group of mosses nearest to *Bartramia* and *Conostomum* in sporophytic characters and to the taxonomically difficult and puzzling genus, *Philonotis*, in gametophytic features. The chromosomes of species of all three of the latter genera have been studied by a host of investigators. We were most fortuntate, therefore, in September, 1959, while collecting on Whiteside Mt. near Highlands, North Carolina, to find *Bartramidula carolinae* Sharp with young capsules suitable for meiotic studies. The present paper presents the results of such studies.

Bartramidula, a genus of about 17 widely distributed species, is represented in North America by only two exceedingly rare species. *Bartramidula mexicana* Schimp. is known only from the type collection from the mountains of Vera Cruz, while *B. carolinae* Sharp has been found only a few times near its type locality in the vicinity of Highlands, North Carolina, in the Southern Appalachians. Other species, some of doubtful validity, are known from Central and South America and adjacent islands. The genus is represented in Europe and eastern Asia by a single species, *B. wilsoni* BSG., apparently the closest relative of the endemic *B. carolinae*, while southeastern Asia and South Africa contain one and two species, respectively. All the species are relatively rare, and many are known only from type collections. The occurrence and near restriction of its species to older land masses which have not been glaciated or submerged since Paleozoic times suggests that *Bartramidula* is a genus of antiquity whose distributional pattern was established long ago. A knowledge of the chromosome number of *B. carolinae*, presumably a relic species of considerable rarity, thus is of more than casual interest.

The plants of *B. carolinae* studied were collected "on moist face of granitic rocks, 4500 ft. alt., north slope of Whiteside Moun-

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tain, east of Highlands, Macon County, North Carolina, *L. E. Anderson, M. Al-Aish & H. Robinson* 14115, Sept. 29, 1959." The plants were taken to the laboratory where they were subjected to cold treatment by storing for two weeks at 2°C., as described by Anderson and Crum (1959). Meiotic chromosomes were studied by means of squash technique using young capsules from which sporocytes were squeezed out in Carnoy's fixative (3:1) and stained, squashed and studied in acetic orcein, as described in detail by Steere, Anderson and Bryan (1954), except that heat was omitted during the staining procedure.

The haploid chromosome number of *B. carolinae* is 24. At MI, 24 darkly stained bivalents were observed (Fig. 1, 2). The meiotic chromosomes are relatively small and rather uniform in size. In figure 1, a polar view of first metaphase, two somewhat larger bivalents are shown, but the remaining bivalents are about the same size. The chromosomes stain evenly and uniformly. No light-staining bivalents were observed. Figure 2 shows a side view of late MI in which the 24 bivalents are about to disjoin. Disjunction is remarkably uniform in all of the bivalents.

Late stages of meiosis were not observed, but there was no evidence of any irregularities or unusual behavior. The chromosomes were easy to press apart and did not exhibit any degree of stickiness or tendency to cohere. The spore mother cells are large, as noted in other members of the Bartramiaceae. Sporocytes are relatively few in the capsules of *B. carolinae*, and only one or two spore mother cells were observed in meiosis in each capsule. Meiosis is presumed, therefore, to extend over a considerable period of time.

The chromosome number, $n = 24$, reported here for *B. carolinae* is the highest yet known for the Bartramiaceae; it is assumed to represent a polyploid number. All the species of *Philonotis* reported on to date (eight species) have the number, $n = 6$; (for a literature summary of chromosome numbers of this genus, see Anderson and Crum, 1959). According to Yano (1957), diploid and tetraploid races occur in *P. socia*, in which dioicous plants have the number, $n = 6$ while monoicous (autoicous?) plants have the number, $n = 12$. This is the only reported case of polyploidy in *Philonotis*.

Several investigators have observed the number, $n = 12$, in *Bartramia ithyphylla*, while *B. pomiformis* and allied varieties and segregates have the number, $n = 8$ (see Anderson and Crum, 1959, and Anderson and Bryan, 1958, respectively, for literature summaries of these species). In the closely allied genus, *Conosto-*

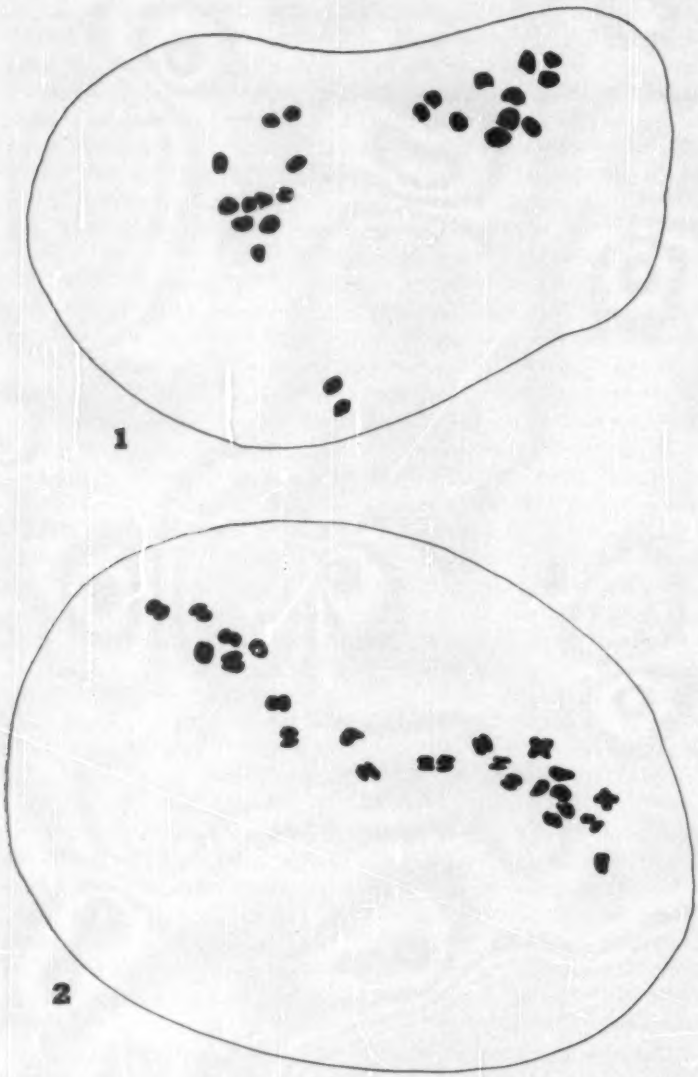

FIG. 1-2. *Bartramidula carolinae* Sharp, n = 24; fig. 1, polar view of MI, showing 24 uniform bivalents; fig. 2, side view of late MI, showing 24 bivalents which are about to disjoin. Note the large size of spore mother cells (S.M.C.) in both figures. (× 2175).

mum, the number, n = 16 (Steere, 1954), has been reported for a single species (*C. tetragonum*), and *Anacolia menziesii* has been found to have haploid numbers of 7 and 8 (Steere, Anderson & Bryan, 1954). A basic chromosome number of 6 (or 3) seems clearly established for the Bartramiaceae. *Anacolia* is doubtless aneuploid, as already mentioned. Chromosome number, however, does not aid particularly in clarifying the systematic position of *Bartramidula*. Since *B. carolinae* is synoicous, it is not improbable that the dioicous species (of which there are several) may prove to have the number, n = 12. Cytologically, therefore, its relationship can be with any of the related genera, whose numbers (as pointed out above) may be 6, 8, 12, or 16.

It is often assumed that relic species have low chromosomes. Therefore, such a high chromosome number in *B. carolinae* is surprising. Sharp (1939) called attention to the fact that the disjunct Appalachian occurrence of this species is interesting when it is considered that the rest of the New World species of *Bartramidula* are tropical. The presence of tropical representatives in the Southern Appalachians is usually accounted for by assuming that they are relics of the once widespread Tertiary flora. The close morphological resemblances, however, between *B. carolinae* and *B. wilsoni*, of Europe, suggest that the relationship of the former may not be with the tropical species, as Sharp suggests. It would be highly desirable to study the chromosome numbers of other populations of *B. carolinae* and to investigate other species, especially *B. wilsoni* and the tropical American species.

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A NEW SPECIES OF RICCIA FROM THE OZARKS

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Riccia ozarkiana n. sp.[2] Thalli small to medium, 2-8 mm. long, loosely gregarious, or subradiate, 1-4 times dichotomous, light green above when living, gray when dry, the same below. Upper surface minutely reticulate. Dorsal groove obtuse except at apex, broad, occupying ⅓ or more of the width of thallus, soon disappearing toward base. Margin ciliate along upper half and obtuse; cilia few to numerous, taper-pointed or obtuse, rather rigid, minutely granular, 100-300 μ long, also scattered on dorsal surface, rarely absent. Chief segments oblong or obcuneate, 1-2 mm. wide; cross-section 2 to 4 times as wide as high, 15-20 cells high in median region, the ventral outline slightly convex toward apex but otherwise nearly rectilinear; terminal segments ovate to oblong. Ventral scales hyaline to whitish, few, inconspicuous. Dorsal epidermis 2-3-stratose; cells of upper layer soon disintegrating and leaving irregularly persistent cusps. Thalli unisexual; antheridial ostioles not prominent, elevated 20-60 μ. Sporangia not numerous. Spores angular, 60-90 μ in longest diameter, somewhat papillate on outer face; wing margin 0-6 μ wide, irregularly crenulate, smooth; outer face irregularly areolate; areolae 6-12 μ wide; papillae obtuse or truncate, 1-3 μ or less long; inner faces similar to outer but much less strongly marked. Chromosome number $n = 8$. TYPE: 6 mi. E. of Baxter Springs, Cherokee Co., Kansas, sandy alluvial deposit, bank of Shoal Creek, Aug. 31, 1948, *R. L. McGregor* 2368 (KANU).

DISTRIBUTION: ARKANSAS: Izard Co., 1 mi. NW. of Calico Rock, sandy alluvial deposit on bank of White River, Aug. 6, 1959, *McGregor* 14961 (KANU). MISSOURI: Barry Co., Roaring River State Park, sandy alluvial deposit at edge of Bass Lake, Aug. 8, 1959, *McGregor* 14981 (KANU). KANSAS: Cherokee Co., 6 mi. E. of Baxter Springs, bank of Shoal Creek, Aug. 31, 1948, *McGregor* 2368; Oct. 9, 1948, *McGregor* 2561; Aug. 10, 1960, *McGregor* 15001.

Riccia ozarkiana differs from *R. beyrichiana* in having prominent dorsal cilia, marginal and dorsal cilia longer and straight, thalli dioecious, spores smaller and smoother, and antheridial

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[2] Dioica, parva vel mediocris, dilute viridis. Frons usque ad 2.8 mm. longa, 1-2 mm. lata, plana, 1-4-furcata, furcis 1-2 mm. latis, apice rotundata vel emarginata, margine et superficie ciliata. Frondis adultis sectio transversalis 2-4-plo latior quam alta. Squamae posticae parvae, evanidae, hyalinae. Ostiola mascula breves. Sporae 60-90 μ, flavae, irregulariter lamellatae, foveolis 6-12 μ, alte pipillatae.

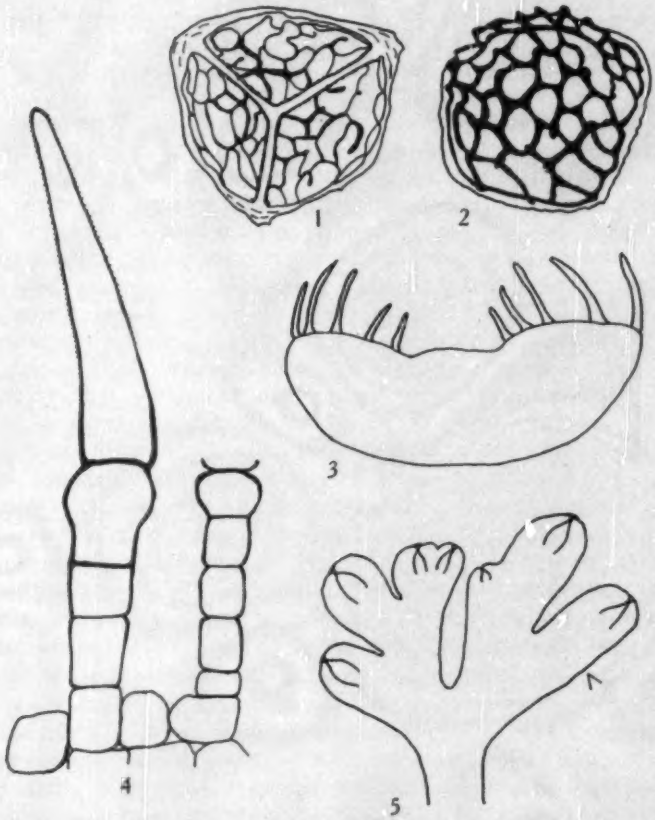

FIG. 1-5. *Riccia ozarkiana.* 1. Inner face of spore, × 485. 2. Outer face of spore, × 485. 3. Transverse section of thallus made at point indicated in fig. 5. 4. Row of cells from dorsal layer with seta, × 485. 5. Habit, × 8.5, setae not shown.

ostioles much less prominent. Spores of *R. ozarkiana* mature in the fall, while those of *R. beyrichiana* mature in the spring.

Associated with *R. ozarkiana,* in all three stations known for the species, are *R. beyrichiana, R. dictyospora, R. hirta,* and *R. frostii.* The colony in Cherokee county has been observed during the past 12 years and has been consistent in its characteristics.

A BRYOLOGICAL CONTRIBUTION FROM FLORIDA

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During a brief visit to Florida in January of 1959 we made a series of careful, though hurried collections throughout the length of the state from the pine woodlands of the northeast to the Everglade swamps at the southern tip of the peninsula. We were surprised to find only 88 different kinds of mosses (82 species, five varieties, and one form), but even more so to realize that such a small series included a good number of considerable interest. Among them were one new species (*Fissidens reesei*), three species and one variety new to the state flora (*Ephemerum crassinervium* var. *texanum*, *Fontinalis flaccida*, *Climacium americanum*, and *Taxiphyllum geophilum*), and no less than 75 county records. Critical examination of previous collections in herbaria have yielded eight additional county records. Only range extensions and a few species of special taxonomic interest are recorded here.

The paltry number of species which we found can be explained by the fact that we collected mainly in areas with few habitats favorable to mosses. Richer collecting areas are to be found in the "panhandle" where limestone sinkholes and steep river bluffs offer protection to a large number of temperate species, a few tropical disjuncts, and even a few endemics. The northeastern pinelands, on the other hand, are extremely poor in species, although localized swampy woods and pocosins, are of some bryological interest. The ancient "Orange Island" of north-central Florida offers few habitats to mosses. A large part of the area has been sadly altered by intensive citrus culture and by other activities of man. A number of limestone sinks and outcrops around springs deserve further attention, however, and the turkey oak sandhills yield a number of pygmies and ephemerals. Southern Florida is very close to sea level, and limestone frequently outcrops at the surface. Unfortunately, a fluctuating water table leaves the rock dry for months each year, and the mosses growing on it are few and, for the most part, of very little interest. The hammocks, islands of woodland surrounded by open swamp or savannah, are the best biological habitats. Tree trunks and logs are especially favorable to mosses, many of them species of widespread occur-

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rence in the American tropics and few of any real interest except as northern outliers of the Caribbean lowland flora.

It is remarkable that our modest collection should include any range extensions at all, considering the host of bryologists who have lived in Florida or have, like us, been there as fugitives from northern winters. Residents, including Severin Rapp, James B. McFarlin, Ruth Schornherst Breen and her students, and even A. J. Grout, have made important and well-publicized collections. By happy chance our collections, though widely scattered, seem to have been made in areas largely neglected by others.

Moss distributions in Florida appear to bear little relation to the fascinating geological history of the state. This history is, however, beautifully reflected by the distribution patterns of many vascular plants, particularly those of tropical affinity now centered in the ancient "Orange Island" area. About 80 species, or one-third of Florida's moss flora (Schornherst, 1943; Breen, 1953), also occur in tropical America, but most of them are lowland calciphiles diffusely distributed locally and so common and so widespread in the American tropics that their origins need not be explained in terms of antiquity. A few disjunct species of restricted distribution in tropical America are known from Florida, but their local distributions are very scantily known as yet. A brief consideration of the phytogeographic history of the state demonstrates the significance of further, strategically directed efforts.

Much of north-central Florida has been continually occupied by plants since its emergence as "Orange Island" during the Oligocene. It was surrounded by warm seas ... some 12 million years before junction with the mainland late in the Miocene. The first flora of the area, unquestionably tropical, was probably derived largely from other islands of the Caribbean area, but it is possible that some tropical elements distributed far northward during the Eocene reached Orange Island as they retreated southward under the influence of the gradual climatic deterioration of the Tertiary. The Miocene Chipola fauna, deposited along the channel between Orange Island and the mainland, was definitely Antillean in facies, but later in the Miocene the cool Chesapeake current brought with it an admixture of northern elements. The trend toward drier, cooler climates continued through the Pliocene and reached a climax in the glacial periods of the Pleistocene. The actual importance of Orange Island as a Pleistocene refuge has been debated by biogeographers; for example, Deevey (1949) believed that pollen profiles from the Pleistocene of the Gulf region indicate a fairly extensive chilling of the southeastern United

States, but Braun (1950) stoutly maintained that "the deciduous forest was not displaced south of the glacial boundary, except in a band of varying width along the ice front, thus continuing the pattern of distribution which had been attained by the close of the Tertiary." It cannot be denied, however, that a great many northern plants took up residence along the Gulf of Mexico. Some clearly boreal species are known there as Pleistocene fossils, and many other characteristically northern species are mingled with the tropical species in the modern floras of Orange Island and other parts of Florida. How and when they arrived is a matter for conjecture. Potzger and Friesner (1939) suggested that meltwater pouring from the ice sheets in tremendous quantity may have altered the temperatures of ground water along river courses sufficiently to account for the migration of northern species far southward in the lowlands, although species of the well-drained uplands may not have been greatly affected. Thus, during the Pleistocene, the Mississippi River valley would have provided a thoroughfare for migration all the way to the Gulf.

St. John (1936) found that the essentially temperate flora of Orange Island includes a remarkable number of ferns of tropical distribution or affinities, nearly half of which are absent from the more tropical latitudes of southern Florida. Woodson (1947) showed that *Asclepias tuberosa* consists of three subspecies apparently derived from ancient centers in the Ozarks, the Southern Appalachians, and Orange Island. Camp (1941) postulated that *Befaria racemosa* was isolated on Orange Island at the fringe of the primary generic dispersal and has, during its long history there, become virtually homozygous. In another paper (1941a), he suggested the possible migration of certain species of *Gaylussacia* from South America to eastern North America via the Antilles and Orange Island. More recently, Heisser (1956) has suggested, among other possibilities, that *Helianthus debilis* ssp. *debilis* may have been introduced into Orange Island during the lower Miocene by long-distance dispersal from western North America, whereas two other subspecies now occuring in Florida may have arrived later, from the northwest, after the island was joined to the mainland. Woodson (1947) suggested that Orange Island may have been available to plants as a fluctuating archipelago even as early as the Cretaceous. He could offer no stratigraphic evidence predating the Eocene but thought that the occurrence in Florida of several endemics of Appalachian or Ozarkian affinities and various relics of obvious antiquity (such as *Torreya*) hint at a pre-Oligocene invasion from the north. The idea is ingenious,

but it is not clear why such plants need be traced beyond the Oligocene. It seems more reasonable to look for a southward migration beginning during the late Miocene, after Orange Island was joined to the mainland and under the influence of cool ocean currents, or later during even more favorable conditions, rather than during the tropical climates of the early Tertiary.

Sphagnum henryense Warnst. *Nassau Co.: Boggy bank of stream, swamp, 7 mi. NE. of Bryceville, 13562.

Fissidens cristatus Wils. *Nassau Co.: Bark at base of tree, hammock, 1½ mi. SW. of Callahan, 13237, 13241; on rotten wood and on bark at base of gum trees, swamp, 7 mi. NE. of Bryceville, 13549 p.p. (with *Anomodon attenuatus*), 13555, 13558.

Fissidens garberi Lesq. & James. *Polk Co.: On exposed root, live oak-palmetto swamp, 9 mi. N. of Wauchula on U.S. 17, 13488 p.p. (with *F. reesei*).

Fissidens radicans Mont. *Polk Co.: On exposed root, live oak-palmetto swamp, 9 mi. N. of Wauchula on U.S. 17, 13488 p.p. (with *F. reesei*).

Fissidens (Semilimbidium) **reesei** n. sp.[2] (Fig. 1-7). Plants small, dull, dark-green, crowded, corticolous. Stems erect, simple (or rarely forked), 5-7 mm. high, rhizoidous only at base. Leaves in (4)11-18 pairs, somewhat falcate at tips when dry, gradually increasing in size toward apex of stem, 1-1.4 mm. long above, oblong to obovate, broadly acute or obtuse, evenly serrulate all around; dorsal lamina tapering to the stem; vaginant laminae up to about ½ the leaf-length, bordered ½-⅔ their lengths by 3-5 rows of linear, hyaline, smooth cells, the border entirely marginal; costa ending 2-5(6) cells below leaf apex; upper median cells hexagonal or slightly elongate, 10-14(16) × 8-11 μ bearing a single small papilla on both surfaces (occasional cells having 2 papillae). Autoicous; perichaetia terminal; perigonia bud-like, numerous, produced singly in the axils of most leaves. Setae 1.7-2.3 mm. long, bent at base, sometimes ± flexuose above. Capsules erect or slight-

* A county record.

[2] Plantae parvae, obscure virides, confertae, corticolae. Caulis erectus, simplex, 5-7 mm. altus. Folia in jugis (4)11-18, siccitate subfalcata, longitudine usque ad 1-1.4 mm., oblonga, lata acuta vel obtusa, ubique serrulata; lamina dorsalis ad caulem attenuata; folia superiores et perichaetiales laminis duplicatis ½ usque ad ⅔ longitudinem marginatis; costa 2-5(6) cellulis sub apice evanida; cellulae hexagonae, 10-14(16) × 8-11 μ, minute unipapillosae. Autoicous; perigonia multa, singule in axillis foliorum producta. Seta 1.7-2.3 mm. longa, prope basem clinata, supra plus minus flexuosa. Capsula 0.5-0.7 mm. longa, erecta vel subinclinata, symmetrica; operculum conico-rostratum, 0.4 mm. longum; dentes peristomii furcati; sporae 16 μ, sphaericae, virides, laeves.

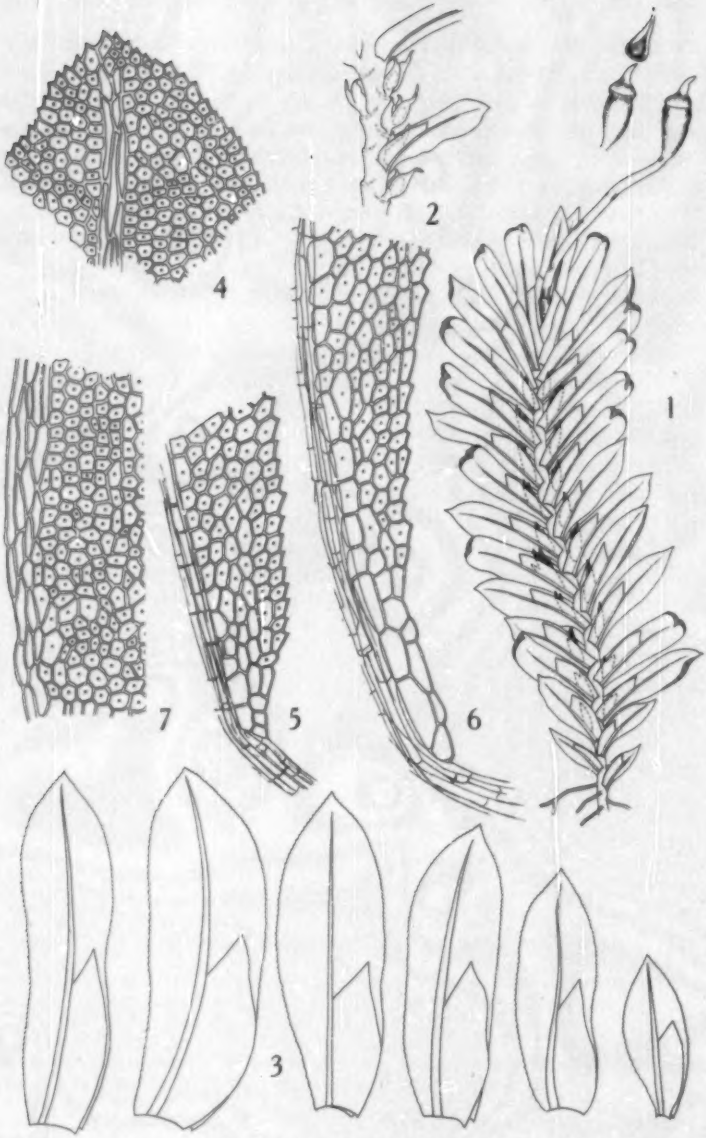

FIG. 1-7. *Fissidens reesei*. 1. Habit sketch of plant, × 17. 2. Portion of stem with leaves removed to show perigonia, × 20. 3. Leaves, × 40. 4. Cells at apex of leaf, × 270. 5-6. Cells of dorsal lamina at insertion, × 270. 7. Cells near base of vaginant lamina showing marginal border, × 270.

ly inclined, symmetric, the urn 0.5-0.7 mm. long, ovoid-cylindric, widest at mouth; operculum conic-rostrate, 0.4 mm. long; exothecial cells and cells of base of operculum collenchymatous; peristome well developed, dark red-brown, finely papillose below, spirally ridged above, forked as much as ½ the way from the apex. Spores spherical, green, smooth, 16 μ.

Bark at base of cypress, Tom Lyles Park, along Fisheating Creek, near Palmdale, Glades Co., Florida, *Lewis E. Anderson & Howard Crum* 13332, Jan. 26, 1959, TYPE, in herb. CAN. On bark near base of cypress tree at edge of small swamp, south bank of Fisheating Creek by U.S. 27, *W. D. Reese* 1329, March 13, 1957. Exposed root, oak-*Sabal* swamp, 8 mi. N. of Wauchula, Polk Co., Florida, *Anderson & Crum* 13488, Jan. 30, 1959. (All the specimens are represented in herb. CAN and DUKE.)

This species is not likely to be confused with any other *Fissidens* of North America, as it is quite distinct in the following characters: leaves oblong, broadly pointed, and evenly serrulate; vaginant laminae of perichaetial and upper leaves clearly bordered in the basal two-thirds or less, the border completely marginal; costa ending 2-4 cells below the leaf tip; leaf cells minutely unipapillose; perigonia very numerous, borne singly in the axils of most leaves. The only related species in Central America and the Caribbean region seems to be *F. muriculatus* Spruce, which has narrower leaves, tapered from well below the apex, and very different papillae which are large, conical protuberances. In the local flora, only *F. donnellii* Aust. resembles this new species in having unipapillose cells; it is completely unrelated, however, as its leaves have no border at all, and the papillae are very large and similar to those of *F. muriculatus*.

We are grateful to Dr. Ronald Pursell, who had previously recognized this as a new species from Dr. Reese's collection cited above, for his comments on the description and for waiving his own rights to publication. The illustrations were prepared by Mary Lou Florian.

Fissidens subbasilaris Hedw. *Nassau Co.: On rotten wood, hammock, 1½ mi. SW. of Callahan, 13247.

Archidium ohioense Schimp. *Marion Co.: On sandy soil among clumps of *Andropogon* in old field, 2 mi. NE. of Belleview, 13296.

Campylopus gracilicaulis Mitt. *Marion Co.: On quartz sand, turkey oak sand hill, 6 mi. E. of Belleview, 13299; on shaded bank, hammock, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13309.

Dicranum condensatum Hedw. *Marion Co.: On quartz sand

turkey oak sand hill, 6 mi. E. of Belleview, 13303; on sand in hammock, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13310.

Octoblepharum albidum Hedw. *Hernando Co.: On very rotten stump, oak-*Sabal* stand, 11 mi. N. of Dade City along Withlahoochee R., 13507. *Marion Co.: On bark of live oak, 2 mi. N. of Citro, 13527; on sand at base of live oak, 4 mi. NE. of Oklawaha on Fla. 464, 13304; on dead palm trunk, hammock, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13308.

Syrrhopodon incompletus Schwaegr. *Marion Co.: On dead palm trunk, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13320; on bark of root and trunk of live oak, 2 mi. N. of Citro, 13522, 13524.—In many widely scattered localities we found both *S. incompletus* and *S. floridanus* Sull., a mere pigeon-hole species which William Reese considers a synonym of *S. incompletus*. We agree with him.

Syrrhopodon ligulatus Mont. *Marion Co.: On oak trunk, hammock, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13316.

Syrrhopodon parasiticus (Sw.) Besch. *Nassau Co.: On rotten wood, hammock, 1½ mi. SW. of Callahan, 13248. *Marion Co.: On bark of sapling live oak, hammock, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13306; on dead twigs and on bark of live oak, 2 mi. N. of Citro, 13526, 13528. *Alachua Co.: On limbs of dead citrus, Island Grove, 13529, 13541. *Polk Co.: On bark of *Carpinus*, live oak-palmetto swamp, 9 mi. N. of Wauchula on U.S. 17, 13493.—Many of the specimens which we collected in many parts of the state could be referred equally well to *S. filigerus* (Aust.) Williams. No. 13526, for example, in a purely quantitative way, belongs there rather than to *S. parasiticus*. William Reese considers the two synonymous, however, and we are in hearty agreement.

Syrrhopodon texanus Sull. *Nassau Co.: On rotten logs and decaying wood, hammock, 1½ mi. CW. of Callahan, 13234, 13242, 13251; on rotten stumps and on roots, swamp, 7 mi. NE. of Bryceville, 13554, 13557, 13559.

Calymperes donnellii Aust. *Hernando Co.: On bark of live oaks and of log, oak-*Sabal* stand, 11 mi. N. of Dade City along Withlahoochee R., 13506, 13513, 13517.

Calymperes richardii C.M. *Collier Co.: On limb of hardwood and on bark at base of sapling, live oak hammock, Royal Palm Hammock, Collier-Seminole State Park, 13441, 13468.

Weissia controversa var. *australis* (Aust.) Schornh. *Nassau Co.: On soil, hammock, 1½ mi. SW. of Callahan, 13246.

Barbula cruegeri Sond. ex C.M. *Collier Co.: On sand between clumps of wire grass, palmetto-pineland, 8 mi. N. of Naples, 13473. Polk Co.: On sandy soil, live oak-palmetto swamp, 9 mi. N. of Wauchula on U.S. 17, 13480.

Desmatodon sprengelii (Schwaegr.) Williams. Alachua Co.: On limestone, Buzzards' Roost, about 8 mi. W. of Gainesville, 13264, 13284 p.p. (with *Fissidens bryoides*). *Collier Co.: On rotten wood, live oak, hammock, Royal Palm Hammock, Collier-Seminole State Park, 13451 p.p. (with *Sematophyllum caespitosum*).

Luisierella barbula (Schwaegr.) Steere. *Dade Co.: On coquina, 2 mi. S. of Dade Co. line on Hwy. 27, NW. of Miami, 13388; on limestone, dry brushy thicket among live oaks, 7 mi. SW. of Homestead, 13368; on limestone, live oak hammock, Royal Palm Hammock, Everglades National Park, 13375.

***Ephemerum crassinervium* var. *texanum* (Grout) Bryan & Anderson. Marion Co.: On sandy soil among clumps of *Andropogon*, old field, 2 mi. NE. of Belleview, 13295.

**Ephemerum spinulosum* Schimp. *Hernando Co.: On disturbed, sandy soil, open oak-*Sabal* stand, 11 mi. N. of Dade City along Withlahoochee R., 13510.

Pohlia cruegeri (Hampe) Andrews. *Dade Co.: On calcareous soil, 2 mi. S. of Dade Co. line on Hwy. 27, NW. of Miami, 13337; on calcareous roadside soil, Royal Palm Hammock, Everglades National Park, 13389. *Collier Co.: On sand between clumps of wire grass, palmetto-pineland, 8 mi. N. of Naples, 13474.

Bryum capillare Hedw. *Glades Co.: On bark at base of cypress, Tom Lyles Park, near Palmdale on Fisheating Creek, 13334.

Mnium affine Bland. *Nassau Co.: On swampy soil, 7 mi. NE. of Bryceville, 13550.

Macromitrium richardii Schwaegr. *Marion Co.: On bark of twigs, hammock, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13312.

***Fontinalis flaccida* Ren. & Card. Nassau Co.: Attached to roots in running water, swamp, 7 mi. NE. of Bryceville, 13563. Dr. Winona Welch kindly confirmed our determination.

***Climacium americanum* Brid. Hernando Co.: On sand, oak-*Sabal* stand, 11 mi. N. of Dade City along Withlahoochee R., 13511. Nassau Co.: On wet soil, creek bank, 7 mi. NE. of Bryce-

** Not previously reported from the state.

ville, 13548, 13551.—In Schornherst's checklist (1943), only *C. kindbergii* (Ren. & Card.) Grout is recorded for Florida. The latter is apparently nothing more than a subaquatic development of *C. americanum* of no taxonomic importance. The specimens cited above are typical of *C. americanum* and not referable to *C. kindbergii*.

Cryphaea glomerata Schimp. *Nassau Co.: On bark of *Carpinus*, hammock, 1½ mi. SW. of Callahan, 13231.

Forsstroemia trichomitria (Hedw.) Lindb. *Nassau Co.: On trunk of sweet gum, hammock, 1½ mi. SW. of Callahan, 13235; on bark of oak, swamp, 7 mi. NE. of Bryceville, 13560. Var. *immersa* (Sull.) Lindb. *Marion Co.: On live oak, 2 mi. N. of Citro, 13525.

Leucodon julaceus (Hedw.) Sull. * Hernando Co.: On bark of turkey oak, 6 mi. S. of Sumpter Co. line, 13518.

Papillaria nigrescens (Hedw.) Jaeg. All of our collections (18 of them) could be referred to the var. *donnellii* (Aust.) E. G. Britt., which Grout (1928-40) characterized as "apparently a habitat form, very easily recognized by the more slender branches, denuded of leaves except a small tuft at the very end." Mrs. Britton (1913) believed the variety to be "simply a xerophytic condition in which the leaves fall off and the terminal branches become brittle, thus propagating the species." After reviewing a great deal of material (including especially all that in the herbaria of the New York Botanical Garden and the National Museum of Canada), we have come to the conclusion that the var. *donnellii* cannot be recognized. *Papillaria nigrescens* is notoriously variable, and any subspecific taxon based on size or general aspect can scarcely be recognized because of intergrading forms. The var. *donnellii* is usually a slender form with flexuose, rather loosely foliate branches, some of which are partly denuded of leaves. The transition to the supposedly typical form is gradual and complete, although denudate branches are rather uncommon in well-developed material. The supposedly typical form is common throughout the American tropics, including Florida, the West Indies, Mexico, Central America, and South America. The variety seems to occupy exactly that range; we have seen abundant material from Louisiana, Florida, New Providence (in the Bahamas), Cuba, Haiti, Jamaica, Mexico, Guatemala, British Honduras, Honduras, Charles Island (in the Galápagos), and Brazil. There are two portions of the type collection of *P. nigrescens* at the New York Botanical Garden. Both are scrappy and unsatisfactory, but one, "Sw. fl. Ind. Occ. Hb. Hooker," once belonging to Mitten's collection, is a slender form

with one partially denudate branch. The other, which Mrs. Britton received from the Swartz herbarium at Stockholm, is similar in aspect but shows no sign of denudation. It can be concluded that the type of *P. nigrescens* is almost certainly the form generally called var. *donnellii*, which, for this and other reasons, must be abandoned.

The so-called *P. appressa* (Hornsch.) Jaeg., characterized by small, flagelliform branches (of varying length) in leaf axils, has also been found a number of times in Florida (though apparently not previously recognized). It occurs throughout the range of the species and is not worthy of any taxonomic recognition at all. The production of such branches is, in fact, rather characteristic of *P. nigrescens*.

We have seen specimens of *P. nigrescens* from the following Florida counties: Alachua, Citrus, Collier, Columbia, Dade, DeSoto, Highlands, Lake, Lee, Levy, Liberty, Manatee, Marion, Monroe, Polk, Seminole, Volusia, and Wakulla. Most specimens came from the trunks and branches of trees (some on bark at base of trees or on exposed roots), and many came from rotten logs and stumps.

Neckeropsis undulata (Hedw.) Reich. *Dade Co.: On exposed roots and on bark at base of hardwood, live oak hammock, Royal Palm Hammock, Everglades National Park, 13370, 13396.

Thelia hirtella (Hedw.) Sull. *Nassau Co.: On tree trunk, 1½ mi. SW. of Callahan, 13240. *Marion Co.: On bark at base of hardwood, hammock, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13323, 13324 p.p. (with *Entodon macropus*).

Anacamptodon splachnoides (Froel.) Brid. *Marion Co.: In knothole of tree trunk, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13322. *Duval Co.: In knothole, depression in pine woods, 3 mi. NE. of Maxville, 13567.—This interesting and frequently overlooked species was only recently reported from Florida for the first time by Crum (1958), who mapped all the known localities in North America. A few other records bring the distribution picture up to date: Iberia and St. Tammany Parishes, LOUISIANA (*W. D. Reese* 1670 & 2112, respectively); Madison Co., VIRGINIA (*F. J. Hermann* 14858); Gatineau Co., QUÉBEC (*H. Crum* & *H. Williams* 10097); Waldo Co., MAINE (*Mrs. W. Keating Johnson*, Aug. 9, 1958). All these additional records are represented in the herbarium of the National Museum of Canada.

Schwetschkeopsis denticulata (Sull.) Broth. *Alachua Co.: On bark at base of tree, Buzzards' Roost, about 8 mi. W. of Gainesville, 13283.

Clasmatodon parvulus (Hampe) Sull. *Nassau Co.: On bark of oak, 7 mi. NE. of Bryceville. 13561.

Leskea australis Sharp. * Hernando Co.: On bark of log and exposed roots of live oak, oak-*Sabal* stand, 11 mi. N. of Dade City along Withlahoochee R., 13508, 13516. *Alachua Co.: On bark at base of hardwood, Island Grove, 13537.

Anomodon attenuatus (Hedw.) Hüb. *Nassau Co.: On bark of gum, swamp, 7 mi. NE. of Bryceville, 13549.

Anomodon minor (P-B.) Lindb. *Alachua Co.: On bark of live oak and at base of tree, Buzzards' Roost, about 8 mi. W. of Gainesville, 13279, 13281.

Haplocladium microphyllum (Hedw.) Broth. *Nassau Co.: On soil, hammock, 1½ mi. SW. of Callahan, 13246 p.p. (with *Weissia controversa* var. *australis*). *Glades Co.: On bark at base of cypress, Tom Lyles Park, Fisheating Creek, near Palmdale, 13330.

Thuidium allenii Aust. *Nassau Co.: On swamp soil and in water (probably because of temporary flooding), swamp, 7 mi. NE. of Bryceville, 13547, 13550 p.p. (with *Mnium affine*).

Thuidium involvens (Hedw.) Mitt. *Alachua Co.: In crevice of limestone cliff, Buzzards' Roost, about 8 mi. W. of Gainesville, 13268. *Collier Co.: On rotten wood, live oak hammock, Royal Palm Hammock, Collier-Seminole State Park, 13443, 13461, 13463 p.p. (with *Haplocladium microphyllum*).

Thuidium minutulum (Hedw.) Mitt. *Nassau Co.: On rotten wood, hammock, 1½ mi. SW. of Callahan, 13252.

Campylium chrysophyllum (Brid.) Bryhn. *Dade Co.: On bark at base of live oak, Royal Palm Hammock, Everglades National Park, 13404 p.p. (with *Sematophyllum adnatum*).

Leptodictyum riparium (Hedw.) Warnst. *Nassau Co.: Attached to roots in running water, swamp, 7 mi. NE. of Bryceville, 13564.

Amblystegium varium (Hedw.) Lindb. *Nassau Co.: On decaying wood, 1½ mi. SW. of Callahan, 13236.

Brachythecium splendens Aust. *Nassau Co.: On rotten wood, hammock, 1½ mi. SW. of Callahan, 13245. *Alachua Co.: On limestone boulders, shaded ravine, Buzzards' Roost, about 8 mi. W. of Gainesville, 13257.

Rhynchostegium serrulatum (Hedw.) Jaeg. *Nassau Co.: On decayed wood, rotten stump, and soil over roots, hammock, 1½ mi. SW. of Callahan, 13238, 13243, 13244 p.p. (with *Entodon macropus*). *Marion Co. On bark of hardwood, live oak grove, 2 mi. N. of Citro, 13539.

Oxyrrhynchium hians (Hedw.) Loeske. *Nassau Co.: On wet soil, hammock, 1½ mi. SW. of Callahan, 13233.

Entodon macropus (Hedw.) C. M. *Nassau Co.: On decaying wood, hammock, 1½ mi. SW. of Callahan, 13244.

Entodon seductrix (Hedw.) C. M. *Hernando Co.: On roots of live oak, oak-*Sabal* stand, 11 mi. N. of Dade City along Withlahoochee R., 13509.

Stereophyllum leucostegum (Brid.) Mitt. *Collier Co.: On rotten log and on roots of trees, live oak hammock, Royal Palm Hammock, Collier-Seminole State Park, 13435.

Sematophyllum adnatum (Mx.) E. G. Britt. *Nassau Co.: On rotten wood, bark of exposed root and bark at base of live oak, live oak hammock, Royal Palm Hammock, Collier-Seminole State Park, 13449, 13463 p.p. (with *Haplocladium microphyllum*), 13464.

Sematophyllum adnatum (Mx.) E. G. Britt. *Nassau Co.: On rotten stump, 7 mi. NE. of Bryceville, 13559 p.p. (with *Syrrhopodon texanus*).—We also collected this species in Alachua, Dade, Duval, and Marion Counties and have seen authentic specimens (in herb. Duke University) from Broward, *Calhoun, *DeSoto, Gadsden, Highlands, Monroe, and Volusia Counties. Substrata mentioned on the labels were the bark of trees (including oak and ash), bark at base of trees, decaying wood, charred stump, and rotten logs.

Sematophyllum caespitosum (Hedw.) Mitt. *Marion Co.: On bark at base of live oak, hammock, edge of Ocala National Forest, 4 mi. SE. of Moss Bluff, 13311. *Alachua Co.: On dead palmetto, Island Grove, 13541 p.p. (with *Syrrhopodon parasiticus*).—Grout, in his *Moss Flora of North America*, gave the American distribution of this species as "on bark of trees and decaying logs, Florida, rare." It appears actually to be rather common (and oddly enough not very variable, in happy contrast to its nature elsewhere in the American tropics), but has been greatly confused with *S. adnatum*. We collected it in Collier, Dade, and Polk Counties, as well, and in the herbarium of Duke University we examined specimens from *Clay, DeSoto, Dade, *Hardee, *Highlands, *Manatee, Orange, *Palm Beach, Seminole, and *Taylor Counties. Among the specimens which had some ecological data 19 came from bark of trees (including palmetto, oak, and orange), one from the bark of a shrub, four from logs and rotten wood, two from roots or bark at base of trees, and one from soil.

Acroporium smallii (Williams) n. comb. *Sematophyllum smallii* Williams, The Bryologist 23: 76. 1920. Dade Co.: Good-

burn Hammock, *J. K. Small* & *C. A. Mosier* 6242 (type, NY, DUKE); Royal Palm Hammock, *J. K. Small* 7153 (DUKE); on rotten log, moist live oak hammock, Royal Palm Hammock, Everglades National Park, *L. E. Anderson* & *H. Crum* 13374 (DUKE, CAN); Costello Hammock, near Silver Palm School, *J. K. Small* & *J. J. Carter* 2816 (DUKE, sub *Sematophyllum adnatum*); on rotten log, Costello Hammock, near Silver Palm, *D. S. Correll* 6102B (DUKE, sub *Sematophyllum adnatum*).—This species, treated as a *Sematophyllum* in Grout's *Moss Flora*, is closely related to the tropical American *Acroporium acestrostegium* (Sull.) Crum & Steere and *A. jamaicense* Crum & Bartr. Williams (1920), however, was aware of its anomalous position in *Sematophyllum*. After the original description he said, "If the furrowing of the [peristome] teeth is to be considered of generic importance, this species would be neither a *Sematophyllum* nor a *Rhaphidostegium*, for the types of both of these genera . . . lack the furrow." The furrow is not a particularly conspicuous feature, but it is clearly demonstrable and in combination with other characters, such as narrowly lanceolate, gradually tapered, concave leaves, linear cells, and erect leaf margins, common to a sizable group of tropical species of similar total aspect, this character assumes undeniable generic importance.

It is impossible to identify this species by Grout's key to *Sematophyllum* in the *Moss Flora*, as the first dichotomy is weak, to say the least: *Acroporium smallii* does *not* grow on rocks. Only three of the specimens cited above were known to Grout. The type almost certainly came from bark or decayed wood, as it is mixed with *Isopterygium micans* and *Octoblepharum albidum*, both characteristic of those habitats; examination of *Small* 7153 clearly shows that it grew on charred wood. Of the remaining, *Small* & *Carter* 2816 has no habitat data on the label but presents no internal evidence suggesting that it grew on rocks. The specimens collected by us and by Correll are known to have come from rotten logs. Further weakness in the key has to do with the posture of the capsule, which is erect or slightly inclined, and therefore not different from the members given in the second part of the key.

Because the original description is faulty in many respects, and the species has been so poorly understood, we present the following redescription:

Plants small and delicate in pale green to golden, glossy mats. Stem and branch leaves similar, wide-spreading and ± homomallous, 0.5-0.7 mm. long, concave, lanceolate, gradually acuminate; margins erect and entire; cells linear, 4-5 cells at basal angles

inflated and hyaline or yellow, supra-alar cells not notably differentiated. Autoicous; inner perichaetial leaves ovate, rather abruptly acuminate, erose-dentate at shoulders, irregularly serrate above, the teeth often recurved. Seat 4-7 mm. long, reddish or red-yellow, smooth; urn of capsule 0.4-0.6 mm. long, erect or slightly inclined, symmetric, contracted below the mouth when dry; annulus none; operculum subulate, longer than the urn, about 0.7-0.85 mm. long; exothecial cells collenchymatous; peristome teeth narrowly furrowed, cross-striolate below, papillose above; endostome segments shorter than the teeth, keeled, not perforated, cilia single, well developed, ± papillose. Spores spherical, very slightly roughened, 13-14 μ. Calyptra cucullate, smooth.

Isopterygium fulvum (Hook. & Wils.) Broth. fo. **latifolium** (Grout) n. comb. *Plagiothecium micans* var. *latifolium* Grout, No. Amer. Musci Pl. 408. 1922. *P. micans* var. *fulvum* fo. *latifolium* (Grout) Grout, Moss Fl. No. Amer. 3: 165. 1932. *Nassau Co.: On base of live oak, hammock, 1½ mi. SW. of Callahan, 13250. *Glades Co.: On bark at base of cypress, Tom Lyles Park, Fish-eating Creek, near Palmdale, 13328.

Isopterygium micans (Sw.) Broth. * Collier Co.: On very rotten wood, Royal Palm Hammock, Collier-Seminole State Park, 13454, 13457 p.p. (with *Octoblepharum albidum*). *Hernando Co.: On sandy soil and on fungus growing on a hardwood, oak-*Sabal* stand, 11 mi. N. of Dade City along Withlahoochee R., 13512, 13514, 13515. *Nassau Co.: On rotten stump, swamp, 7 mi. NE. of Bryceville, 13559 p.p. (with *Syrrhopodon texanus*). *Isopterygium micans* var. **minus** (Grout) n. comb. *Plagiothecium micans* var. *minus* Grout, Moss Flora No. Amer. 3: 165. 1932. Polk Co.: On decaying wood, live oak-palmetto swamp, 9 mi. N. of Wauchula on U.S. 17, 13483.

****Taxiphylum geophilum*** (Aust.) Fl. Nassau Co.: Base of live oak, 1½ mi. SW. of Callahan, 13250. Alachua Co.: On limestone and on clayey, calcareous soil, Buzzards' Roost, about 8 mi. W. of Gainesville, 13259, 13268 p.p. (with *Thuidium involvens*), 13274, 13277, 13284 p.p. (with *Fissidens bryoides*).—The Florida record for *Taxiphyllum planissimum* (Mitt.) Broth., a tropical American species scarcely distinct from some of the many expressions of *T. geophilum*, should be checked very carefully.

Mittenothamnium diminutivum (Hampe) E. G. Britt. *Collier Co.: On rotten wood, live oak hammock, Royal Palm Hammock, Collier-Seminole State Park, 13443 p.p. (with *Thuidium involvens*), 13463 p.p. (with *Haplocladium microphyllum*).

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NOTES ON POGONATUM ALPINUM IN EASTERN UNITED STATES AND CANADA

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The distribution of *Pogonatum alpinum* (Hedw.) Röhl. in eastern North America, especially its southernmost extension, is not well known. Frye (1937), in his monograph of the *Polytrichaceae,* reported this species only as far south as New York, although earlier Curtis (1867) had reported it from North Carolina, Porter (1904) from Pennsylvania, and Ammons (1934) from West Virginia. Whether these published records were merely

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overlooked or based on misdeterminations has remained uncertain since Frye made no mention of them.

I have recently examined a number of specimens from several herbaria in an attempt to clarify the distribution of this alpine moss and found that it does occur in the mountains of Pennsylvania, West Virginia, and North Carolina (Fig. 1). Although the voucher specimen for the North Carolina report by Curtis is missing, there is a specimen in the United States National Herbarium collected in 1880 by J. D. Smith on Roan Mountain, Mitchell Co. I have also collected it on Roan Mountain, where it was growing in rock crevices on an exposed cliff face at Roan High Bluff (alt. 6267 ft.).

Pogonatum alpinum is probably more widely distributed south of New York than present collections indicate, even though there

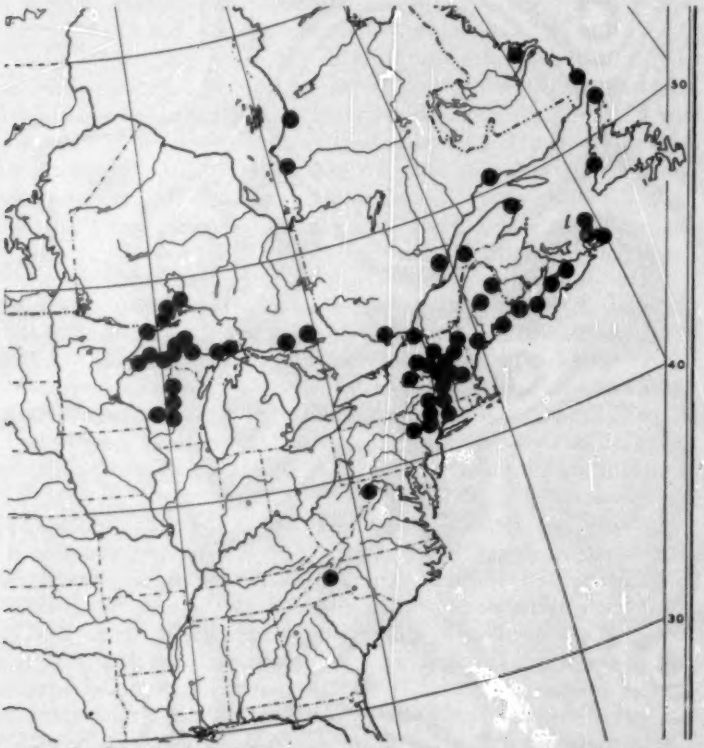

FIG. 1. Distribution of *Pogonatum alpinum* in the eastern United States and Canada.

are only a few montane localities with suitable habitats. Probably it is usually present in the spruce-fir zone (5000 ft. or above) of the Southern Appalachians where cool, humid conditions prevail, and it may also occur at slightly lower altitudes near waterfalls or streams. In these situations it usually is found on soil over rocks or in crevices of rocks on cliff ledges.

One reason that very little is known of the distribution of this species could be the fact that it superficially resembles and has been misdetermined as a *Polytrichum*. When in fruit, *Pogonatum alpinum* is easily distinguished by its terete capsule, in contrast to the angled capsule of *Polytrichum;* when sterile, the remarkable similarity of the two genera renders separation in the field almost impossible. Sometimes, however, the type of branching of the stem may serve as a reliable character. If the stem bears from two to four branches, one can be reasonably certain that it is *Pogonatum alpinum*, since *Polytrichum* usually has a simple stem or rarely a stem with one branch. Microscopically, there is little similarity between the two genera. In a cross-section of a leaf, the terminal cells of the lamellae in *Pogonatum alpinum* are pyriform with very thick, densely papillose walls. Sterile specimens of *Polytrichum ohioense* Ren. & Card. have at times been confused with the alpine moss. Sometimes the lamellae of *P. ohioense* have terminal cells that are oval and slightly crenulate, instead of flat-topped and smooth.

The only *Pogonatum* likely to be confused with *Pogonatum alpinum* in eastern North America is *P. urnigerum* P.-Beauv. This species with capsules is quite distinctive, but when sterile it could be mistaken for *P. alpinum* var. *brevifolium* Brid. The terminal cells of the lamellae in these two mosses are too similar to be used as a reliable taxonomic character. A more reliable character is the cells of the central region of the leaf sheath: in *P. urnigerum* wide (10-15 μ) and short (24-37 μ), in var. *brevifolium* narrower (6-9 μ) and longer (40-100 μ).

Pogonatum alpinum appears to be one of the most variable of all the North American Polytrichaceae. Frye listed five varieties, including var. *alpinum*, and I have seen all but one, var. *septentrionale*, from the eastern United States and Canada (TABLE 1). A report of var. *septentrionale* by Cheney and Evans (1944) from Bayfield Co., Wisconsin, is based on a misdetermined specimen of *Pogonatum urnigerum*. It is doubtful whether var. *arcticum* can be separated from var. *alpinum* since the taxonomic characters for this variety seldom appear in the combination listed in Frye's key (TABLE 1.) For example, a specimen may have the short leaves

(7-8 mm.) and the simple stem of var. *arcticum* but at the same time possess the characteristic capsule of var. *alpinum*. Or a specimen may have the much branched stem and long leaves (9-11 mm.) of var. *alpinum* but have the long narrow capsule characteristic of var. *arcticum*. I have seen every possible combination of characters. Perhaps it would be best if var. *arcticum* were included with var. *alpinum*, but no definite conclusion can be made until there has been a complete study of the western North American material.

TABLE 1. Varieties of *Pogonatum alpinum* in the eastern United States and Canada, showing morphological characters taken from Frye's key to the Polytrichaceae.

Variety	Leaf length	Capsule length	Capsule length: width	Stem
alpinum	9-11 mm.	4-5 mm.	2-3:1	much branched
brevifolium	4-8 mm.	1.8-4 mm.	2-3.5:1	simple or with few branches
arcticum	7-8 mm.	4-5 mm.	3-5:1	simple or with few branches
macounii	12-14 mm.	5-6 mm.	3-4:1	rarely branched

SPECIMENS EXAMINED

I have examined specimens in the herbaria of the U.S. National Museum, New York Botanical Garden, National Museum of Canada, the Universities of Michigan, Tennessee, West Virginia, and Wisconsin, and Duke and Yale Universities. I wish to thank the curators of these institutions for the loan of material.

CANADA. LABRADOR: Koksoak River, *Low* 47 (CAN); Cape Charles and Dish Water Bay, *Waghorne* 3729 (CAN). NEWFOUNDLAND: St. Anthony, *Savile & Vaillancourt* 1639, 2096 (CAN); Curling, *Long* 113 (TENN). NOVA SCOTIA: Long Island, Cape Breton Co., *Schofield* 6220 (CAN); Truro, Colchester Co., *Prince* 6432 (WIS); Sandy Cove, Digby Co., *Schofield* 6251 (CAN); Big Southwest Brook, Inverness Co., *Schofield* 4880 (CAN); Cape Split, Kings Co., *Schofield* 5886, 5912 (CAN); Gold Brook, Victoria Co., *Schofield* 6152 (CAN). QUEBEC: Mt. St. Hilaire, *Dupret* (Holzinger's *Musci Acrocarpi Boreali-Americani* 200) (US; CAN; MICH; WIS; YALE); St.-Urbain, Charlevoix Co., *Hedley, Raymond & Kucyniak* 45-111 (MICH); Tourelle, Gaspé Co., *Lepage* 3030 (DUKE); Kingsmere, Gatineau Co., *Crum* 2971 (US; CAN; MICH); Seven Islands, Saguenay Co., *Robinson* 935 (MICH); St. Epiphane, Temiscouata Co., *Lepage* 2649 (DUKE); Fort George, *Lepage* 6273 (US); Richmond Gulf, *Marr* M319, M322, M345, M379 (MICH). NEW BRUNSWICK: Grand Manan, Charlotte Co., *Taylor* 44 (MICH). ONTARIO: Lake Timagami,

Nipissing District, *Darker* 1505 (MICH); Bear Lake, Sudbury District, *Cain* 2656 (MICH); Silver Mt., Thunder Bay District, *Garton* 5491 (CAN); NE. of Port Arthur, Thunder Bay District, *Garton* 2780 (US; CAN); Nipigon Provincial Forest, *Crum & Anderson* 7707A, 7716, 7734, 7785, 7792 (CAN; DUKE).

UNITED STATES. MAINE: Auburn, Androscoggin Co., *Chamberlain* 915 (US); New Limerich, Aroostook Co., *Chamberlain* 532 (US); Mt. Desert Island, Hancock Co., *Rand*, June 21, 1890 (CAN; NY); Mt. Katahdin, Piscataquis Co., *Allard* 5210g (US). NEW HAMPSHIRE: Mt. Washington, Coos Co., *Haring*, Aug. 11, 1939 (NY); Crawford Notch, Grafton Co., *James* 44-5 (US); Mt. Monadnock, Hillsboro Co., *Haring*, Aug. 15, 1938 (NY). VERMONT: Mt. Mansfield, Chittenden Co., Grout, July 3, 1896 (NY); Fairlee, Orange Co., *Mathias* 202a (NY); Sherburne, Rutland Co., *Dutton* 1304 (DUKE); S. Wardsboro, Windham Co., *Grout* (Grout's *North American Musci Perfecti* 63) (US; CAN; MICH; TENN; YALE); Plymouth, Windsor Co., *Grout*, June, 1931 (NY). NEW YORK: Mt. Marcy, Essex Co., *Killip* 12686 (US); Hunter, Greene Co., *Britton*, July 31, 1898 (NY); Indian Lake, Hamilton Co., *Greenalch*, Aug. 20, 1898 (NY); cliffs of the Delaware River, Orange Co. (NY); Cragsmoor, Ulster Co., *Rathbun*, Aug. 18, 1917 (US); Lake George, Warren Co., *Jelliffe* 8 (NY). MASSACHUSETTS: Mt. Everett, Berkshire Co., Britton, Sept. 29, 1897 (NY). CONNECTICUT: Salisbury, Litchfield Co., *Collins* 3994 (YALE). PENNSYLVANIA: Buckhill Falls, Monroe Co., *Porter*, Sept. 10, 1869 (NY). MICHIGAN: Pictured Rocks, Alger Co., *Myers*, July 26, 1941 (WV); Black River, Gogebic Co., *Ihenberry* 382 (NY; TENN); Silver Mt., Houghton Co., *Richards* 122 (MICH); gorge of Taquamenaw River, Luce Co., *Nichols*, July, 1935 (YALE); Mt. Bohemia, Keweenaw Co., *Sharp*, Sept. 1, 1937 (TENN); Isle Royale, Keweenaw Co., *Povah* 162 (MICH); Huron Mt. region, Marquette Co., *Nichols* 208 (MICH; NY; YALE); south of Carp Lake, Ontonagon Co., *Nichols & Steere*, Aug. 20-27, 1935 (YALE). WISCONSIN: Dells of Wisconsin River, Adams Co., *Pammel* 19 (WIS); Oak Island, Ashland Co., *Cheney* 6028 (WIS); Houghton, Bayfield Co., *Cheney* 5473, 5476, 5477a (WIS); Juneau Co., *Evans*, May 1, 1948 (DUKE; MICH; TENN); Pine River, Lincoln Co., *Cheney* 2853 (WIS); between Masinee & Wausau, Marathon Co., *Cheney* 3236 (WIS). MINNESOTA: Grand Marais, Cook Co., *Holzinger* (Holzinger's *Musci Acrocarpi Boreali-Americani* 73) (US; MICH; NY; WIS). WEST VIRGINIA: Ice Mt., Hampshire Co., *Ammons* 1405 (WV). NORTH CAROLINA: Roan Mt., Mitchell Co., *J. D. Smith*, July 30, 1880 (US); Roan Mt., Mitchell Co., *Ireland* 1523, 2554 (US).

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NOTES ON KANSAS MOSSES

ARTHUR A. CRIDLAND[1]

The mosses reported here substantiate records considered doubtful in McGregor's (1950) comprehensive survey of Kansas mosses, or are reported for the first time from the state; several range extensions of species infrequently reported from Kansas are also included. Since McGregor's publication a few other notes on Kansas mosses, by McGregor and Hartman (1956), Hartman (1956), and Cridland (1959), have appeared. I am grateful to Dr. Lewis E. Anderson for verifying the records of plants new to Kansas and for advice on several difficult taxonomic problems. I am also grateful to Dr. R. L. McGregor for comments and discussion.

Bruchia sullivantii Aust. On noncalcareous sandstone, "Hole-in-the-Rocks," Baldwin Junction, Douglas Co., NE. ¼ NW. ¼ Sect. 2, T. 15 S., R. 19 E., *Cridland* 269, 30 May 1959. Sand dunes near Hutchinson, Reno Co., *S. W. Jackson* (*Cridland* 228), 10 May 1959.

Aschisma kansanum Andrews. At the base of quartz pebbles in open prairie, 16 mi. W. of Medicine Lodge, Barber Co., Sect. 20, T. 32 S., R. 14 W., *R. L. McGregor* 14177, 25 Apr. 1959. This material, collected in a habitat similar to that described by Cridland (1959), grew only at the base of a few of the numerous quartz pebbles examined. Many of the plants have almost mature sporophytes with the capsules containing immature spores.

Astomum muhlenbergianum (Sw.) Grout. Roadside bank 5 mi. SE. of Lawrence, Douglas Co., S. ½ NW. ¼ Sect. 13, T. 13 S., R. 20 E., *Cridland* 4, March 1958.

Hyophila tortula (Schwaegr.) Hampe. On noncalcareous, micaceous sandstone in an intermittent tributary of Coal Creek, oak woodland (Baldwin Wood) 2 mi. N. of Baldwin City, Douglas Co., NE. ¼ Sect. 28, T. 14 S., R. 20 E., *Cridland* 125, 22 Sept. 1957. On noncalcareous sandstone in a dry creek bed, oak woodland near the lake in Woodson Co. State Park, SE. ¼ Sect. 11, T. 26 S., R. 14 E., *Cridland* 141, Sept. 1957.

Acaulon triquetrum (Spruce) C.M. On open ground between grasses in a sandy prairie 2 mi. N. of Arlington, W. of State Highway 14, Reno Co., SE. ¼ Sect. 27, T. 24 S., R. 8 W., *Cridland* 129, 130, 22 Nov. 1958.

Phascum cuspidatum var. *americanum* Ren. & Card. Slightly calcareous soil of a north-facing road bank, about 5 mi. SE. of Lawrence, Douglas Co., S. ½ NW. ¼ Sect. 13, T. 13 S., 20 E., *Cridland* 23, 253, March 1958. Wet pasture beside a pond, 2 mi. N. of Valley Falls, Jefferson Co., *Cridland* 24, 22 Feb. 1958. Noncalcareous soil in Kickapoo Cemetery, Leavenworth Co., NE. ¼ Sect. 33, T. 7 S., R. 22 E., *Cridland* 242, May 1959. Among grasses in a salt marsh 17 mi. NE. of Stafford, Stafford Co., Sect. 23, T. 21 S., R. 11 W., *Cridland* 208, 30 Jan. 1958.

Aloina brevirostris (Hook. & Grev.) Kindb. On a north-facing slope,

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on silty calcareous soil among buffalo grass (*Buchloë dactyloides*), 2 mi. SE. of Meade, Meade Co., NW. ¼ Sect. 25, T. 32 S., R. 28 W., *Cridland* 212, 18 May 1958. The genus has not been previously reported from Kansas, and the assignment of this collection to *A. brevirostris* is tentative, as no sex organs were found. There were only six plants in a collection of widely scattered and poorly developed mosses growing in a very dry prairie, where they were associated with *Pterigoneuron subsessile*, *Bryum* sp., and several indeterminable members of the Pottiaceae. The occurrence on silty calcareous soil is in agreement with the habitat for *A. brevirostris* described by Steere (1950).

Ephemerum crassinervium (Schwaegr.) Hampe. Carpeting the noncalcareous soil of a stubble wheat field, 2 mi. S. of the junction of Federal Highway 50 and State Highway 14, W. of Hutchinson, Reno Co., *Cridland* 136, 22 Nov. 1958.

Ephemerum cohaerens (Hedw.) Hampe. Very common among grasses in a salt marsh 17 mi. NE. of Stafford, Stafford Co., Sect. 23, T. 21 S., R. 11 W., *Cridland* 77, 30 Jan. 1958. Associated with *Aphanorhegma serratum* on mud by the lake in Miami Co. State Park, SW. ¼ SW. ¼ Sect. 5, T. 19 S., R. 24 E., *Cridland* 56, 5 Oct. 1958.

Pyramidula tetragona (Brid.) Brid. In a ditch and on a roadside verge near Rock City at Minneapolis, Ottawa Co., *Cridland* 58, 276, 2 Apr. 1958. Open prairie among grasses and *Yucca*, 1½ mi. S. of Lincoln, Lincoln Co., *Cridland* 279, 2 Apr. 1958.

Physcomitrium collenchymatum Gier (1955). On noncalcareous sandy soil, bank of an intermittent tributary of Coal Creek, oak woodland (Baldwin Wood) 2 mi. N. of Baldwin City, Douglas Co., NE. ¼ Sect. 28, T. 14 S., R. 20 E., *Cridland* 98, 22 Sept. 1957.

Aulacomnium heterostichum (Hedw.) BSG. Noncalcareous banks in oak woodland (Baldwin Wood) 2 mi. N. of Baldwin City, Douglas Co., NE. ¼ Sect. 28, T. 14 S., R. 20 E., *Cridland* 61, 22 Sept. 1957.

Lindbergia brachyptera (Mitt.) Kindb. Trunk of a fallen black walnut (*Juglans nigra*) in Baldwin Wood, 2 mi. N. of Baldwin City, Douglas Co. NE. ¼ Sect. 28, T. 14 S., R. 20 E., *Cridland* 117, 22 Sept. 1957. Ascending the north side of the trunk of an elm tree (*Ulmus americana*) to a height of 9 in., 50 yards N. of the campanile, University of Kansas, Lawrence, Douglas Co., *Cridland* 91, 14 Sept. 1957 (det. L. E. Anderson). Crum (1956) has recently seen and verified the specimen of *L. brachyptera* collected by Henry in Saline County.

Fabronia ciliaris (Brid.) Brid. On the trunk of an elm (*Ulmus americana*) in front of Strong Hall, University of Kansas, Lawrence, Douglas Co., *Cridland* 163, Apr. 1958 (det. L. E. Anderson).

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THE BRYOLOGICAL FORAY OF THE NINTH INTERNATIONAL BOTANICAL CONGRESS

Harvey A. Miller[1]

On August 15, 1959, 24 bryologists from six nations (*fig.* 9 and 10) met in Montreal for transportation by automobile to the Mont Tremblant region of the Laurentian Mountains some 80 miles north of the city. Headquarters for the foray was located at the Pines Hotel on Lac Maskinongé a few miles from St. Jovite, Quebec. Arriving in late afternoon, the participants had an opportunity to get settled before a leisurely dinner and an informal evening of gossip on the lawn.

The first excursion was made to the valley of a cascading brook near Mont Tremblant Lodge (*fig.* 2). The vegetation, typical of much of southeastern Canada, consisted of second growth sugar maple and yellow birch, and the bryophytes were mostly common and widespread species of the deciduous forests of eastern North America. Particularly abundant mosses were *Dicranum scoparium, Thuidium delicatulum, Pohlia nutans, Hypnum reptile, H. curvifolium, Leucobryum glaucum, Brotherella recurvans, Heterophyllium haldanianum,* and *Tetraphis pellucida,* to name but a few, and such hepatics as *Bazzania trilobata, Barbilophozia barbata, Ptilidium pulcherrimum, Jamesoniella autumnalis, Pellia epiphylla,* and *Lophocolea heterophylla* were exceedingly common. On well-drained slopes *Polytrichum commune* and *Pleurozium schreberi* grew in loose association with *Lycopodium clavatum* and various reindeer mosses. A few plants of *Buxbaumia aphylla* were found scattered among lichens on a dry slope. On cliffs and steep banks along the stream were *Diphyscium foliosum, Isopterygium muellerianum, Rhabdoweisia denticulata, Pterygynandrum filiforme, Leskea nervosa, Pogonatum alpinum, Scapania nemorosa,* and *Tritomaria exsectiformis. Grimmia alpicola* var. *rivularis, Blindia acuta, Andreaea rupestris, Hygrohypnum eugyrium,* and *H. ochraceum* were

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FIG. 1-8. Scenes from the foray in the Mont Tremblant area. 1. Foray leader Howard Crum watches operation of the ski lift. 2. *Foreground,*

collected on stones outcropping from the stream bed, and *Fontinalis dalecarlica* grew in the water with *Platyhypnidium riparioides*. *Climacium dendroides* formed miniature forests on soil, and tree trunks bore scattered fringes of *Neckera pennata*, *Pylaisia selwynii*, *Ulota crispa*, and *U. ludwigii*, as well as *Frullania asagrayana* and *F. eboracensis*. Wet soil along a track supported *Trematodon ambiguus* in great abundance.

At noon we assembled near the cars for a box lunch and then proceeded over a rough, rain-washed road to the next major collecting site. Enroute, stops were made at road cuts where *Pogonatum urnigerum*, *P. pensilvanicum*, and *Ditrichum pusillum* had colonized recently exposed silt banks. The final stop of the day was made in the densely wooded valley of a pleasant brook near the Devil River ski lodge. Here *Paraleucobryum longifolium*, *Rhodobryum roseum*, *Hypnum crista-castrensis*, *Mnium punctatum*, *Rhytidiadelphus squarrosus*, *Hylocomium umbratum*, *Brachythecium rivulare*, and *Amblystegiella subtilis* were common. *Pellia epiphylla* was abundantly represented, as were *Scapania undulata*, *Jamesoniella autumnalis*, and *Chiloscyphus pallescens* var. *fragilis*.

In late afternoon the damp and pleasantly fatigued explorers retreated to the hotel for dry, unmuddied clothes and a warming beverage before dinner. A good dinner in the French Canadian style taken leisurely in the dining room overlooking the lake framed by evergreens rounded out an interesting and eventful day.

The second day trips were made to two peat bogs in the southern sector of Mont Tremblant park near the biological station at Lac Monroe. The first bog was relatively young with an open pond in the center (*fig. 7*) where *Drepanocladus fluitans* was collected partially submerged on the edge of the mat. Few hepatics were encountered in the open bog region, although *Pallavicinia*

Father Conan Taylor and Seville Flowers; *left to right*, E. A. (Ted) Schelpe, Frank Hilferty, Lionel Jaffe, Fred Hermann, Jane Taylor, Lewis Anderson, Howard Crum, Everett Stone, Y. Kuwahara, Claire Davison. 3. Lewis Anderson renders an opinion for (*left to right*) Frank Hilferty, Geneva Sayre, Seville Flowers, and Sinske Hattori. 4. Getting the information straight; (*left to right*) Harry Williams, Howard Crum, Seville Flowers, Fred Hermann. 5. Claire Davison and Margaret (Peg) Feigley peer through handlenses, and E. A. Schelpe and Clarence Hand look on as Lionel Jaffe points out an unrecognized species to Harry Williams. 6. Jane Taylor examines a specimen, while Margaret Feigley gives it a closer check. 7. In the open, younger bog near Lac Monroe; Kjeld Holmen collects in the foreground, and Lewis Anderson figures prominently at right. 8. Lunch time at the biological station; (*left to right*) Lionel Jaffe, E. A. Schelpe, Frank Hilferty, Mrs. Hand, and Clarence Hand.

FIG. 9-10. Group photographs taken at the Lac Monroe biological station. 9. Back row (*left to right*): Mrs. Clarence Hand (Canada), Lillian Nagel (U. S.), Y. Kuwahara (Japan), Claire Davison (Canada), Lionel Jaffe (U. S.) Middle row (*left to right*): Frank Hilferty (U.S.), Kjeld Holmen (Denmark), Arthur Cridland (U. S.), Margaret Feigley (U. S.), Howard Crum (Canada), Jane Taylor (England), Seville Flowers (U. S.), Lewis Anderson (U. S.), Harry Williams (Canada), Albert Courtemanche (Canada), Fred Hermann (U.S.), Sinske Hattori (Japan). Front row (*left to right*): Harvey (Al) Miller (U. S.), Father Conan Taylor (U. S.), Clarence Hand (Canada), E. A. Schelpe (South Africa), Kenneth Wagner

lyellii was observed. It was interesting to many that an area of *Sphagnum*, apparently *S. magellanicum*, was in good reproductive condition. Although most of the capsules had already shed their spores, it was possible to find specimens in which the capsules were not yet broken open. In the *Larix* and *Thuja* zone surrounding the open portion of the bog, *Ptilidium pulcherrimum* was extremely abundant on fallen logs. Dwarf mistletoe was found on twigs of black spruce. The enthusiasm for this bog was slightly dampened by a rather heavy mist but, nonetheless, it was a rewarding experience and a good lesson in ecological succession. At the completion of the visit to the open bog, the group traveled to the nearby biological station where the director, Professor Albert Courtemanche, welcomed all.

Although the hotel had prepared a box lunch for the participants, the biological station graciously provided a very pleasant and welcome spread of various salad vegetables and, more important to the rain-soaked bryologists, an abundant supply of good hot soup and coffee. After lunch (*fig.* 8), the formal photograph (*fig.* 9) was taken, and Prof. Courtemanche invited inspection of facilities of the laboratory. He described the various research projects being undertaken in such diverse fields as entomology, ichthyology, and limnology and explained that all kinds of biological specialists are encouraged to study the plants and animals indigenous to the Mont Tremblant region. He pointed out that many of the bryophyte species had been studied by Mr. James Kucyniak but that there were many more areas remaining to be explored and that the rugged and diverse nature of the topography lent itself to a great variety of habitats in a very restricted geographical area.

A mature bog with no exposed water was the second field stop of the day. The open portion of the bog was carpeted with a lush red mat of *Sphagnum*. *Pallavicinia lyellii* was fairly abundant, and *Cladopodiella fluitans* and *Microlepidozia setacea* were found in their usual intimate association with *Sphagnum*. The visit to this bog was cut short as the mist became a downpour, and hasty retreat followed.

As the cars crept and bounced back toward St. Jovite, the rain stopped, and there was some scattered clearing. As the visibility was much improved, Dr. Crum carried out earlier arrangements for a trip up the slopes of Mont Tremblant on the chair lift. At

(U. S.), and Mrs. Wagner (U. S.), Geneva Sayre and Everett Stone were not present when the picture was taken. 10. A light-hearted shot taken by Sinske Hattori.

the summit, activity was centered around sight-seeing and photography. At the conclusion of this very pleasant and spectacular interlude, the chalet was invaded for a bit of late afternoon refreshment before returning to the hotel to process the day's collections and other private activities.

The final day was spent in the exploration of some steep cliffs just north of La Conception in Labelle County near St. Jovite. A species of *Fossombronia* was encountered on clay soil in a field, but the author was unable to find sporophytes. Proceeding to the cliff region, we were shown a habitat rich with such species as *Encalypta ciliata, Saelania glaucescens, Oreoweisia serrulata, Amphidium lapponicum, Plagiothecium roseanum, Plagiopus oederi, Distichium capillaceum, Homalia jamesii,* and *Rhytidium rugosum.* The steep valley forming a notch between the two cliffs was a jumble of huge boulders gripped by the roots of small trees. Half-rotted trunks bridged the crevasses between the rocks. And everywhere there was moss—glorious festoons of *Hylocomium splendens* forming a golden upholstery over rock faces, the gay yellow-green of *Pleurozium schreberi,* dark green mats of *Mnium orthorhynchum* interrupted now and then by shining *Plagiothecium roeseanum* and neatly combed *Dicranum scoparium.* The mass effect was one of great beauty in untamed nature. Cliffs and their accompanying talus, especially if conditions are moist and the situation a little protected, can be rich collecting areas because of the tremendous variety of microhabitats available. This last stop on the foray was a striking example of such a small geographical area having great ecological diversity. In addition to species mentioned previously, *Gymnostomum aeruginosum, Eurhynchium pulchellum, Thuidium delicatulum,* and *Ulota hutchinsiae* may be listed to indicate something of the nature of the flora. Hepatics were also abundant here, and collections were made of *Plectocolea hyalina, Jamesoniella autumnalis, Cephalozia media, Solenostoma crenulatum, Plagiochila asplenioides, Ptilidium pulcherrimum, Frullania eboracensis, Barbilophozia barbata, Tritomaria exsectiformis,* and *T. quinquedentata.*

In spite of the intermittent mist and rain which persisted throughout the foray, spirits were bright, and the warmth of companionship in common interest overshadowed the weather. Leader Dr. Howard Crum (*fig.* 1) did an excellent job of organization and in selection of areas to be visited. His interest in the non-bryological appetites of his colleagues was expressed in arrangements for small groups to visit a weaver's home and shop where colorful handmade materials were on display and available for

purchase. Dr. Lewis Anderson and Mr. Harry Williams, both of whom had worked with Dr. Crum in preparation of the excursion, were most helpful in the field in pointing out interesting species and assisting in determinations (*fig.* 3 and 5).

Those who attended Field Trip 17 (Bryology) of the Ninth International Botanical Congress enjoyed a pleasant and enrichening experience from the personal point of view as well as the bryological. The spirit of friendship and co-operation with colleagues over the world was revitalized and increased as a result of common experience. It was in this last area, above all, that the trip achieved the greatest and most lasting of its several successes.

BRYOPHYTES OF THE MONT TREMBLANT AREA

HOWARD CRUM[1] and HARRY WILLIAMS[2]

During preparations for the bryological foray preceding the Ninth International Botanical Congress (August of 1960), numerous trips were made to the vicinity of Mont Tremblant, near St. Jovite, Quebec, and rather extensive collections were made there, by the senior author alone or accompanied at various times by the junior author, by Harold Whitehouse of Cambridge University, and by Lewis E. Anderson of Duke University. The present report, intended as a modest supplement to H. A. Miller's account of the foray, includes all the bryophytes known to occur in easy range of Mont Tremblant—a total of 183 mosses and 75 liverworts. To avoid needless repetition, generalized collecting sites are listed below and referred to only by number thereafter. The only localities visited during the foray were numbers 1, 2, 3, 12, 15, and 16, but no doubt any of the species known from the entire area could have been collected in the few localities visited by members of the foray.

A representative series of specimens have been deposited in the herbarium of the National Museum of Canada.

LOCALITIES

1. Mont Tremblant Lodge (at SE. end of Lac de la Montagne Tremblante), Terrebonne Co.
2. Devil River Ski Lodge (about 7 mi. E. of Mont Tremblant Lodge), Terrebonne Co.

[1] National Museum of Canada, Ottawa.
[2] Millbrook, Ont.

3. Along the Chemin Duplessis 2-3 mi. E. of Mont Tremblant Lodge, Terrebonne Co.
4. Lac Supérieur (about 8 mi. E. of Mont Tremblant Lodge), Terrebonne Co.
5. Lac Ouimet, Terrebonne Co.
6. St. Jovite, Terrebonne Co.
7. Lac Mercier, Terrebonne Co.
8. Lac Gauthier (E. of Lac Ouimet), Terrebonne Co.
9. Lac Bibitte, near SE. end of Lac de la Montagne Tremblante, Terrebonne Co.
10. Conception Station (on the Canadian Pacific Railway W. of Lac Mercier), Labelle Co.
11. Lac Verte (NW. of Lac Mercier and E. of the Canadian Pacific Railway), Labelle Co.
12. La Conception and vicinity, Labelle Co.
13. Chute au Diable at trail to Lac Croche, 4.3 mi. N. of the Lac Monroe biological station, Parc de la Montagne Tremblante, Montcalm Co.
14. Chute au Diable (portage no. 2), 5.4 mi. N. of the Lac Monroe biological station, Parc de la Montagne Tremblante, Montcalm Co.
15. Lac Shaw bog, 1.1 mi. N. of the entrance to the Parc de la Montagne Tremblante, Montcalm Co.
16. Lac aux Atocas, 2.2. mi. N. of the entrance to the Parc de la Montagne Tremblante, Montcalm Co.

MUSCI

Abietinella abietina (Hedw.) C.M. 12
Amblystegiella subtilis (Hedw.) Loeske 2, 12
Amblystegium juratzkanum Schimp. 10
A. serpens (Hedw.) BSG 10, 11
Amphidium lapponicum (Hedw.) Schimp. 1, 12, 14
Andreaea rupestris Hedw. 1, 6
Anomodon attenuatus (Hedw.) Hüb. 1, 2, 12
A. rostratus (Hedw.) Schimp. 12
A. rugelii (C.M.) Keissl. 2
Atrichum angustatum (Brid.) BSG 1, 7, 5, 12
A. undulatum (Hedw.) P-B. 1, 2
Aulacomnium palustre (Hedw.) Schw. 1, 8
Barbula convoluta Hedw. 1
B. fallax Hedw. 6
B. unguiculata Hedw. 12
Bartramia pomiformis Hedw. 1
Blindia acuta (Hedw.) BSG 1, 14
Brachythecium flagellare (Hedw.) Jenn. 1, 2, 3
B. populeum (Hedw.) BSG 9, 12
B. reflexum (Starke) BSG 1, 3, 10, 13
B. rivulare BSG 1, 2
B. salebrosum (Web. & Mohr) BSG 10, 11, 12
B. starkei (Brid.) BSG 9
Brotherella recurvans (Mx.) Fl. 1, 13
Bryhnia novae-angliae (Sull. & Lesq.) Grout 1, 2, 8
Bryoerythrophyllum recurvirostrum (Hedw.) Chen 12
Bryum argenteum Hedw. 11
B. caespiticium Hedw. 1
B. capillare Hedw. 1, 7
B. cuspidatum (BSG) Schimp. 1, 12
B. pallescens Schleich. 7
B. pseudotriquetrum (Hedw.) Schw. 1, 2, 8, 12
Buxbaumia aphylla Hedw. 1
Calliergon cordifolium (Hedw.) Kindb. 8, 12
C. stramineum (Brid.) Kindb. 1, 8
Campylium chrysophyllum (Brid.) Bryhan 12
C. hispidulum (Brid.) Mitt. 1, 2, 11, 12

C. polygamum (BSG) Bryhn 12
Ceratodon purpureus (Hedw.) Brid. 1, 5
Climacium dendroides (Hedw.) Web. & Mohr 1
Dicranella heteromalla (Hedw.) Schimp. 1
D. varia (Hedw.) Schimp. 6
Dicranum drummondii C.M. 1
D. flagellare Hedw. 1
D. fulvum Hook 1, 12
D. fuscescens Turn. 1
D. montanum Hedw. 1, 3, 7, 13
D. rugosum Brid. 1
D. scoparium Hedw. 1, 9
D. viride (Sull. & Lesq.) Lindb. 1, 13
Diphyscium foliosum (Hedw.) Mohr 1, 12
Distichium capillaceum (Hedw.) BSG 12
Ditrichum lineare (Sw.) Lindb. 3, 11
D. pusillum (Hedw.) Britt. 2, 3, 7
Dolichotheca striatellum (Brid.) Loeske 1, 7, 12
Drepanocladus aduncus var. *polycarpus* fo. *gracilescens* (BSG) Mönk. 12
D. exannulatus (Gümb.) Warnst. 7
D. fluitans (Hedw.) Warnst. 1, 15
D. uncinatus (Hedw.) Warnst. 1, 2, 8, 14
var. *plumosus* (Schimp.) Ren. 1
Encalypta ciliata Hedw. 12
E. streptocarpa Hedw. 12
Entodon cladorrhizans (Hedw.) C.M. 12
Eurhynchium pulchellum (Hedw.) Jenn. 1, 7
Fissidens adianoides Hedw. 12
F. cristatus Wils. 1, 2, 3, 9, 12
F. bryoides Hedw. 1
F. osmundioides Hedw. 1, 14
Fontinalis dalecarlica BSG 1, 2
F. novae-angliae Sull. 2
Funaria hygrometrica Hedw. 1
Grimmia affinis Hornsch. 12
G. alpicola Hedw. 1
var. *rivularis* (Brid.) Broth. 1
G. apocarpa Hedw. 6, 12
Gymnostomum aeruginosum Sm. 12
Hedwigia ciliata (Hedw.) P-B. 1
Heterophyllium haldanianum (Grev.) Kindb. 1, 2, 7
Homalia jamesii Schimp. 1, 3, 13
Hygrohypnum eugyrium (BSG) Loeske 1
H. ochraceum (Turn.) Loeske 1
Hylocomium splendens (Hedw.) BSG 1, 7
H. umbratum (Hedw.) BSG, 1, 2
Hypnum curvifolium Hedw. 1
H. fertile Sendt. 1
H. imponens Hedw. 1, 12
H. lindbergii Mitt. 1, 12, 13
H. reptile Mx. 1, 2, 10, 13
Isopterygium muellerianum (Schimp.) Lindb. 1
Leskea obscura Hedw. 1, 4, 6, 10
L. polycarpa Hedw. 1
Leskeella nervosa (Schw.) Loeske 1, 2
Leucobryum glaucum (Hedw.) Schimp. 1, 9
Leucodon sciuroides (Hedw.) Schw. 2, 11
Lindbergia brachyptera (Mitt.) Kindb. 6, 11
Mnium affine Bland. 1
M. cuspidatum Hedw. 1
M. drummondii BSG 1
M. lycopodioides BSG 12
M. medium BSG 8
M. orthorhynchum Brid. 1, 12
M. punctatum Hedw. 1, 7
M. spinulosum BSG 1, 7, 13
M. stellare Hedw. 11
Myurella julacea (Schw.) BSG 12
M. sibirica (C.M.) Reim. 12
Neckera pennata Hedw. 1, 2, 12
Oncophorus wahlenbergii Brid. 1
Oreoweisia serrulata (Funck) DeNot. 1, 12, 14
Orthotrichum elegans Hook. & Grev. 2, 4, 5
O. obtusifolium Brid. 1, 2, 4, 6, 10
O. ohioense Sull. & Lesq. 2, 4
O. stellatum Brid. 1, 2, 4
Paraleucobryum longifolium (Hedw.) Loeske 1, 3
Philonotis caespitosa Wils. 2
var. *laxa* (Warnst.) Loeske & Warnst. 1
P. fontana (Hedw.) Brid. 7, 12
Plagiopus oederi (Brid.) Limpr. 12

Plagiothecium denticulatum (Hedw.) BSG 1
var. *tenellum* BSG 1, 13
P. laetum BSG 1
P. roeseanum (Hampe) BSG 1, 12
P. sylvaticum (Brid.) BSG 1, 11
Platygyrium repens (Brid.) BSG 1, 2
Platyhypnidium riparioides (Hedw.) Dix. 1, 3
Pleurozium schreberi (Brid.) Mitt. 1
Pogonatum alpinum (Hedw.) Röhl. 1, 2
P. pensilvanicum (Hedw.) Par. 2
P. urnigerum (Hedw.) P-B. 3, 7
Pohlia annotina var. *decipiens* Loeske 7, 11
P. bulbifera (Warnst.) Warnst. 1, 7
P. cruda (Hedw.) Lindb. 1, 6, 12
P. elongata Hedw. 1
P. nutans (Hedw.) Lindb. 1
P. proligera Lindb. 1
Polytrichum commune Hedw. 1, 2, 7
P. gracile Sm. 8
P. juniperinum Hedw. 1, 7
var. *alpestre* (Hoppe) BSG 8
P. ohioense Ren. & Card. 1
P. piliferum Hedw. 1
Pterygynandrum filiforme Hedw. 1, 12
Ptilium crista-castrensis (Hedw.) DeNot. 1, 2
Pylaisia intricata (Hedw.) Schw. 1, 2
P. polyantha (Hedw.) BSG 11
P. selwynii Kindb. 1, 10
Rhabdoweisia denticulata (Brid.) BSG 1, 4, 7, 12
Rhacomitrium aciculare Brid. 1
R. heterostichum (Hedw.) Brid. 1
var. *affine* (Schleich.) Jens. 1
fo. *obtusum* (Sm.) Mönk. 1, 6
var. *ramulosum* (Lindb.) Jones 1
Rhodobryum roseum (BSG) Limpr. 1, 12
Rhytidiadelphus squarrosus (Hedw.) Warnst. 2, 8
R. triquetrus (Hedw.) Warnst. 1, 12
Rhytidium rugosum (Hedw.) Brid. 12
Saelania glaucescens (Hedw.) Broth. 12
Sphagnum capillaceum (Weiss) Schrank 1, 8
var. *tenellum* (Schimp.) Andr. 8, 15
S. centrale Jens. 8, 12
S. dusenii Jens. 16
S. fimbriatum Wils. 8
S. fuscum (Schimp.) Kling. 8
S. girgensohnii Russ. 1, 8, 12
S. magellanicum Brid. 8, 16
S. plumulosum Röll. 8
S. recurvum P-B. 1, 9
S. robustum (Russ.) Röll. 1
S. squarrosum Crome 1
S. teres (Schimp.) Ängst. 15
S. warnstorfianum DuRietz 8
S. wulfianum Girg. 8
Tetraphis pellucida Hedw. 1, 3
Thuidium delicatulum (Hedw.) Mitt. 1
T. recognitum (Hedw.) Lindb. 1, 12
Tortella tortuosa (Turn.) Limpr. 12
Trematodon ambiguus (Hedw.) Hornsch. 1, 12
Trichostomum cylindricum (Bruch) C.M. 1
Ulota crispa (Hedw.) Brid. 1, 2
U. hutchinsiae (Sm.) Hamm. 1, 2, 12, 13
U. ludwigii Brid. 1, 2, 12
Zygodon viridissimus (Dicks.) R. Br. 2

HEPATICAE

Anastrophyllum michauxii (Huds.) Buch 12, 13, 14
Anthoceros laevis L. 12
Asterella tenella (L.) P-B. 12
Barbilophozia attenuata (Mart.) K.M. 12
B. barbata (Schmid.) Loeske 1, 12
Bazzania denudata (Torr.) Trev. 9, 12
B. tricrenata (Wahl.) Trev. 1, 14
B. trilobata (L.) Gray 1
Blasia pusilla L. 1, 7, 11
Blepharostoma trichophyllum (L.) Dum. 1
Calypogeia meylanii Buch 8
C. muelleriana (Schiffn.) K.M. 1, 8
C. suecica (Arn. & Pers.) K.M. 14

Cephalozia bicuspidata (L.) Dum. 1
C. media Lindb. 13
Cephaloziella hampeana (Nees) Schiffn. 14
C. rubella (Nees) Douin 1, 16
Chiloscyphus pallescens var. *fragilis* (Roth) K.M. 1, 2
Cladopodiella fluitans (Nees) Joerg. 15
Cololejeunea biddlecomiae (Aust.) Evans 1, 12
Conocephalum conicum (L.) Dum. 1
Fossombronia sp. (ster.) 12
Frullania asagrayana Mont. 1
F. bolanderi Aust. 10
F. eboracensis Gottsche 1, 10, 12
Geocalyx graveolens (Schrad.) Nees 1
Harpanthus scutatus (Web. & Mohr) Spruce 1, 2
Jamesoniella autumnalis (DC.) St. 1, 2, 7, 12
Jungermannia lanceolata L. 1
Leiocolea badensis (Gottsche) Schiffn. 12, 14
Lejeunea cavifolia (Ehrh.) Lindb. 1, 7, 12
Lepidozia reptans (L.) Dum. 1
Lophocolea heterophylla (Schrad.) Dum. 1, 7, 13
L. minor Nees 11, 12
Lophozia alpestris (Schleich.) Evans 12, 14
L. bicrenata (Schmid.) Dum. 1, 12
L. incisa (Schrad.) Dum. 1, 2, 13
L. longidens (Lindb.) Mac. 1
L. porphyroleuca (Nees) Schiffn. 13
L. silvicola Buch 1, 13
Mannia fragrans (Balb.) Frye & Clark 12
Marchantia polymorpha L. 11
Marsupella emarginata (Ehrh.) Dum. 1, 12, 14
Metzgeria conjugata Lindb. 13
M. furcata (L.) Lindb. 1, 12
Microlepidozia setacea (Web.) Joerg. 15
Mylia anomala (Hook.) Gray 8
Nowellia curvifolia (Dicks.) Mitt. 1, 2, 3, 13, 14
Pallavicinia lyellii (Hook.) Gray 15
Pellia epiphylla (L.) Corda 1
Plagiochila asplenioides (L.) Dum. 1, 12, 16
Plectocolea crenuliformis (Aust.) Mitt. 12
P. hyalina (Lyell) Mitt. 1, 2
Porella platyphylla (L.) Lindb. 1
P. platyphylloidea (Schwein.) Lindb. 1, 2, 11, 12
Preissia quadrata (Scop.) Nees 12
Ptilidium ciliare (L.) Nees 1, 12
P. pulcherrimum (Web.) Hampe 1
Radula complanata (L.) Dum. 2, 12
Reboulia hemisphaerica (L.) Raddi 12
Riccardia latifrons (Lindb.) Lindb. 1, 2
R. palmata (Hedw.) Carr. 2
Scapania apiculata Spruce 2
S. cuspiduligera (Nees) K. M. 1
S. gymnostomophila Kaal. 12
S. irrigua (Nees) Dum. 1, 8
S. mucronata Buch 1, 12, 14
S. nemorosa (L.) Dum. 1, 2, 7, 12, 14
S. undulata (L.) Dum. 2
Solenostoma crenulatum (Sm.) Mitt. 11, 12
Sphenolobus hellerianus (Nees) St. 1, 2, 13, 14
S. minutus (Crantz) St. 1, 12
Tritomaria exsecta (Schmid.) Schiffn. 1
T. exsectiformis (Breidl.) Schiffn. 1, 7, 14
T. quinquedentata (Huds.) Buch 12, 14

†WALTER BIGLER KIENER (1894-1959)

S. I. FUENNING[1]

Walter Bigler Kiener was born October 18, 1894 in Berne, Switzerland. His education was interrupted at the age of 15 when his mother died. According to tradition, he was apprenticed to his father, who owned a small butcher shop and sausage-making business. He had to help his father provide for a large family. Dr. Kiener sensed the butcher trade was not his vocational calling and realizing the inadequacy of his formal education attended night courses. Because of restlessness and lack of interest in a trade, resulting in difficulty with his father, Dr. Kiener found escape in the mountains. He learned to master mountaineering, which eventually led him to an inquiry of natural history and increased his thirst for knowledge. During World War I, he became a member of the Swiss Citizen Army and was compelled to spend considerable time in active service as a frontier guard. In November 1922, at the age of 28, Dr. Kiener came to the United States and worked in a packing house in New York. After seven months, he left for Denver where he would be able to see the mountains. He found employment as foreman sausage-maker in a small plant. Week-ends were usually spent in the mountains, and evenings were spent attending classes in citizenship and English.

In January 1925, he became involved in a mountain tragedy. In a sacrificial attempt at rescue, parts of his fingers and feet were lost, thus ending his trade career. A few months later, he became a ranger in the Rocky Mountain National Park, which position he held for five years. During this time he met many professional people who encouraged him to continue his education.

Dr. Kiener entered the University of Nebraska as an Adult Special Student. During attendance at the university, in 1929, he became a citizen of the United States. Also during this time, in response to many demands, he made lantern slides from many of his photographs of the Swiss Alps and the Colorado Rockies and lectured extensively with outstanding success for several years. He received his A.B. degree in 1930. As a matter of routine, he became a laboratory assistant. In 1931 he obtained his master's degree in science and was elected to Sigma Xi.

In the early 1930's, during the depression, Dr. Kiener asked to be allowed to choose some phase of the alpine vegetation on Longs

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Walter Bigler Kiener (1894-1959)

Peak for particular investigation. The difficulty of this pioneer work stimulated Dr. Kiener to study and collect lichens extensively outside the alpine zone. In 1940, Dr. Kiener received his Ph.D. from the University of Nebraska.

His home in Lincoln, Nebraska, where he resided up to the time of his death, was made into a workshop for natural history studies. He had an extensive herbarium of lichen specimens, which was the result of over 20 years of work and study.

Dr. Kiener held the following positions: Assistant in Botany, University of Nebraska (1930-1940); Ecologist, Conservation and Survey Division (1941-1943); Biologist, State Game and Foresta-

tion and Parks Commission, Nebraska (1943-1955). He made studies in the ecology of alpine vegetation of the Rocky Mountains, the limnology of Nebraska, and the ecology and taxonomy of cryptogamic vegetation. Dr. Kiener was credited with founding the Game Commission's Fisheries Research Department. He was a noted writer and lecturer on subjects ranging from Aquatic Biology to Alpine Vegetation. Those who knew Dr. Kiener regarded him highly for his professional work.

PUBLICATIONS

Unisexual limber pines. Science 82: 193. 1935.

Primula parryi. Gardeners' Chron. 40: 58-59. 1936.

On the history of the vegetation of Rocky Mountain National Park. Colo. Forester 1937: 24-25. 1937.

Alpine vegetation on Longs Peak, Colorado. Amer. Bot. 45: 100-105. 1939.

Peltigera on Longs Peak, Colorado, and in Iowa County, Iowa. The Bryologist 42: 142-149. 1939.

"*Catillaria herrei*," a transfer of honor by misspelling, and not a lichen. The Bryologist 52: 166. (1949) 1950.

During a trip to Mexico in 1945, Dr. Kiener visited high altitudes on both Popocatepetl and Ixtacihuatl. His moss collections, published by E. B. Bartram (The Bryologist 52: 23-27. 1949), included two new species, *Pleuridium kieneri* and *P. exsertum*. A moss collected on Longs Peak in 1932 was described by R. S. Williams (The Bryologist 38: 92-94. [1935] 1936) as *Splachnobryum kieneri*.

Dr. Kiener's thirst for knowledge was so intense that he proved in every way that one can achieve a goal in learning if the desire is strong enough to work in any capacity and to sacrifice. Dr. Kiener sacrificed the close relationship of his family in Switzerland to come to the United States and find lasting satisfaction in his ideals, which he could not find from manual work. However, his qualities as a skilled craftsman greatly benefited him in being self-supporting during the first seven months in New York and during his stay in Denver while furthering his education. He had handicaps to combat, such as language difficulty, especially in college. He had general difficulties inherent in a sudden switch from manual to mental work, the need for self-support, and the re-learning of the use of his maimed hands and feet. But, despite all of his handicaps, he maintained high ethical principles and always sought the truth. Because of this, he was frequently misunderstood and misinterpreted.

Dr. Kiener died on August 24, 1959 at the Lincoln General Hospital.

RECENT LITERATURE ON LICHENS—32[1]

WILLIAM L. CULBERSON[2]

AHMADJIAN, V. A contribution toward lichen synthesis. Mycologia 51(1): 56-60. 5 fig. 1959. [Studies on *Lecanora dispersa* (Pers.) Röhl.]

——— [&] ELISABET HENRICKSSON. Parasitic relationship between two culturally isolated and unrelated lichen components. Science 130(3384): 1251. 1 fig. 1959. ["The presence of numerous haustoria, with accompanying death of the algal cells, was noted in a mixed culture of the fungal symbiont . . . of *Collema tenax* (Sw.) Ach. em. Degel. and *Trebouxia impressa* Ahm."]

ASAHINA, Y. Lichenologische Notizen (§150-153). Jour. Jap. Bot. 34(8): 225-230. 8 fig. 1959. [New: *Parmelia nodakensis* n. sp., *Usnea glabrescens* subsp. *asiatica* n. subsp.]

———. Lichenologische Notizen (§154-156). *Ibid.* 34(10): 289-292. 3 fig. 1959. [New: *Usnea glabrescens* subsp. *pseudocolorans* n. subsp.]

BESCHEL, R. E. The copper swamp in the Aboushagan Woods, North Sackville, N.B. Summary for the Maritime Excursion After the 9th International Botanical Congress in Montreal, September 7th, 1959. 6 pp. Queens Univ., Kingston, Ontario. 1959. [Mimeographed. Several lichens.]

BREUER, H. & T. MÜLLER. Über die Vegetation der "Scharren" im Kreis Bitburg/Eifel. Decheniana 111(2): 169-175. 1959. [26 lichens, 17 mosses; sociological data.]

BURK, C. J. A floristic study of a sandhill area on the North Carolina Coastal Plain. Jour. Elisha Mitchell Sci. Soc. 75(2): 135-138. 1959. [*Cladonia sylvatica* is erroneously reported from the area in this paper.]

ČERNOHORSKÝ, Z. Dr Miroslav Servit mrtev. Preslia 31(4): 431. 1959.

CIFERRI, R. [G. Lindau & P. Sydow's] Thesaurus Literaturae Mycologicae et Lichenologicae. Supplementum 1911-1930. A-D. 689 pp. Casa Editrice Renzo Cortina. Pavia. 1957. [7,167 unannotated references.]

———. [G. Lindau & P. Sydow's] Thesaurus Literaturae Mycologicae et Lichenologicae. Supplementum 1911-1930. E-K. 690-1476 pp. Casa Editrice Renzo Cortina. Pavia. 1958. [8128 unannotated references.]

CURTIN, C. B. Studies on the tardigrades. II Some tardigrades from Maryland. Proc. Pennsylvania Acad. Sci. 31: 142-146. 7 fig. 1957. [The animals inhabit lichens.]

DIX, W. L. Some Mexican lichens. The Bryologist 62(2): 148-149. 1959. [14 spp.]

GALLÉ, L. Adatok Keszthely és környéke zuzmóflórájához. [Analecta ad floram Lichenum regionis oppidi Keszthely.] Bot. Közlemenyek 46(3-4): 223-233. 1956. [74 taxa.]

GROVER, P. K. & T. R. SESHADRI. Constitution of pinastric acid. Tetrahedron 6: 312-314. 1959.

HALE, M. E. JR. New or interesting Parmelias from North and tropical America. The Bryologist 62(2): 123-132. 4 fig. 1959. [10 spp. New: *Parmelia allardii** n. sp., *P. epiclada** n. sp. with *v. laciniata** n. v., *P.*

[1] The names of new taxa from the Americas are marked with an asterisk (*).

[2] Dept. of Botany, Duke University, Durham, N. C.

norstictica nom. nov. for *P. jamaicensis* Vain. non (Ach.) Spreng., *P. phlyctina** n. sp., *P. subinvoluta** n. sp.]

HENSSEN, A. Über Lebermoosfunde aus dem nordwestlichen Enontekiö-Lappland. Nova Hedwigia 1(1): 65-76. 1 map. 1959. [Several lichens.]

HISAUCHI, K. How and when the Japanese name "Hanagoke" came to be used for *Cladonia rangiferina*. Misc. Bryol. et Lichenol. 19: 3-5. 1 fig. 1959. [In Japanese.]

KASK, M. (editor). Botanical Research in the Estonian S.S.R. 52 pp. Acad. Sci. Estonian S.S.R., Inst. Zool. & Bot., Tartu State Univ., Chair of Systematic Bot. & Geobot. 1959. [In English. Lichenology (pp. 14-16); bryology (pp. 16-17).]

KLEMENT, O. Die Flechtenvegetation des Siebengebirges und des Rodderberges. Decheniana, Beih. 7: 5-56. 2 pl. 6 tab. 1959 [154 spp. New: *Physcia hucana* (Harm.) n.c.]

———. Zur Soziologie subarktischer Flechtengesellschaften. Nova Hedwigia 1(2): 131-156. 1959. [Many spp.]

KUROKAWA, S. *Anaptychia hypoleuca* (Mühl.) Mass. Misc. Bryol. et Lichenol. 20: 1-3. 1959. [In Japanese.]

———. Iso- or isosyntypes from U.S. National Herbarium, Smithsonian Institution. *Ibid.* 20: 3. 1959. [In Japanese.]

———. New localities of four Japanese lichens. *Ibid.* 21: 3-4. 1959.

———. Noteworthy lichens collected by Dr. M. Tagawa. *Ibid.* 17: 3-4. 1958. [10 spp. New: *Leptogium menziesii* v. *dissectum* f. *spathulatum* n. f., nom. nud. In Japanese.]

——— & H. INOUE. Lichens and hepatics of Mt. Akagi, Gunma Pref. *Ibid.* 20: 3-4. 1959. [30 lichens. In Japanese.]

LAMB, I. M. Lichens. Scientific American 201(4): 144-146, 148, 150-152, 154, 156. illus. 1959. [Semi-popular article.]

LEPAGE, E. Premier supplément au catalogue des lichens du Québec. Nat. Canad. 85: 169-198. 1958. [Many spp.]

MAAS GEESTERANUS, R. A. Note on *Lecidella carpathica* Körb. Blumea 9(2): 626-628. illus. 1959. [New: *Lecidea carpathica* f. *distrata* (Arn.) n.c., f. *laevigata* (Magn.) n.c.]

MATTICK, F. Bericht über einen Forschungsaufenthalt in den Vereinigten Statten 1957. Wildenowia 2(2): 143-150. 1959. [Report of a lichenological trip.]

MOYCHO, W., M. GUBANSKI, A[LDONA] RENNERT. Wyciąg z porostu *Cetraria islandica* inhibitorem wirusa mozaiki tytoniowej. An extract from the lichen *Cetraria islandica* as an inhibitor of TMV. Acta Soc. Bot. Poloniae 28(1): 185-193. 2 fig. 5 tab. 1959. [English summary. The extract seems to inhibit tobacco mosaic virus.]

MÜLLER, T. Die Flechten der Eifel. Nachtrag 1958. Decheniana 111(2): 177-198. 22 tab. 1959. [91 taxa. Sociological data.]

———. Über die Vegetation des Ermberges bei Baasem/Westeifel. *Ibid.* 111(2): 159-168. 1959. [92 lichens, 24 mosses.]

[NAKANISHI, S.] [Phytosociological studies on the epiphytic plant community (I). On the epiphytic plant community *Abies firma* forest (Iwao National Forest, Hyogo Pref.).] Bull. Fac. Education, Kobe Univ. 21: 47-58. 6 tab. 1959. [Some lichens, many bryophytes. In Japanese, English summary.]

PIŠÚT, I. Lišajnik *Lecanora crassa* (Huds.) Ach. v Stratenskej Hornatine.

[Die Flechte *L. c.* im Gebirgsgebiet von Stratena.] Prírodovedný Sborn. Slovenského Múz. [Acta Rerum Nat. Mus. Slovenici] 4: 86-87. 1958.

———. Lichenologische Bemerkungen. Preslia 31 (3): 273-276. illus. 1959. [*Cladonia deformis, C. amaurocraea* and *C. uncialis.*]

REIJNDERS, W. J. De mosflora van het Amsterdamse Bos. [Moss flora of a woodland near Amsterdam.] Buxbaumia 9(1-2): 19-28. 1955. [15 lichens. English summary.]

———. De mossen en lichenen van de Amsterdamse bachstenen grachtmuren. [Mosses and lichens on canal walls in Amsterdam.] *Ibid.* 12(1-2): 21-25. 1958. [8 lichens. English summary.]

RITCHIE, J. C. The vegetation of northern Manitoba. III. Studies in the subarctic. Arctic Inst. North Amer., Tech. Paper No. 3. Montreal. 56 pp. 8 fig. 8 pl. 12 tab. 1959. Price: $2.00. [47 lichens, 75 mosses.]

SAITO, T. Lichens of Mt. Higashi-Azuma, Fukushima. Misc. Bryol. et Lichenol. 17: 4-5. 1958. [About 60 taxa. In Japanese.]

SATO, M. Distribution and ecology of *Gyrophora esculenta* Miyoshi. Jour. Jap. Bot. 33(4): 110-115. 3 fig. 1958. [In Japanese, English summary.]

———. Catalogus Lichenum japonicorum (ed. 2). Misc. Bryol. et Lichenol. 19: 11-12; 20: 9-12; 21: 7-10. 1959. [Alphabetic checklist of genera and species, A to *Cladonia*; to be continued. The second and third installments lack the title and the name of the author.]

TRASS, H. Eesti NSV lihhenofloora haruldaste ja huvitavate liikide levik II. [Distribution of rare and interesting species of Estonian S.S.R. lichen-flora II.] Eesti NSV Teaduste Akad. Juures Asuva Loodusuurijate Seltsi Aastaraamat 51: 189-198. 1958. [*Cladonia polydactyla* Flk., *C. brevis* Sandst., *C. cerasphora* Vain., *C. delicata* (Ehrh.) Flk., *C. tenuis* (Flk.) Harm., *Pilophoron cereolus* (Ach.) Th. Fr.]

TÜXEN, R., A. VON HÜBSCHMANN & W. PIRK. Kryptogamen- und Phanerogamen-Gesellschaften. Mitteil. der. floristisch-soziol. Arbeitsgemeinschaft, N.F. 6-7: 114-118. 1957. [Reference to lichens.]

VĚZDA, A. Doplňky k lišejníkům Telečska. Nachträge zur Flechtenflora des Bezirkes Telc (Mähren). Acta Mus. Silesiae, ser. A. 8: 59-63. 1959. [23 taxa.]

———. Lichenes Bohemoslovakiae Exsiccati, Editi ab Instituto Botanico Universitatis Agriculturae et Silviculturae, Brno, ČSR. Fasciculus X. Dec. 28-30 (1959). 8 pp. [Labels.]

———. Lichenes Bohemoslovakiae Exsiccati, Editi ab Instituto Botanico Universitatis Agriculturae et Silviculturae, Brno, ČSR. Index fasciculorum I-X (no. 1-300). 7 pp.

WILHELMSEN, J. B. Chlorophylls in the lichens *Peltigera, Parmelia,* and *Xanthoria.* Bot. Tidsskr. 55(1): 30-36. 1959. [Chromatography on powdered sugar column and spectrophotometry. "The chlorophyll contents were smaller in lichens than in leaves of higher plants and smaller in summer than in winter."]

WILLIAMS, L., K. LEGG & F. S. L. WILLIAMSON. Breeding of the Parula warbler at Point Lobos, California. The Condor 60(6): 345-354. 2 fig. 1958. [The birds nested in festoons of *Ramalina reticulata* (Noedh.) Krempelh. Good photographs.]

WILMANNS, O. Zur Kenntnis des *Toninion coeruleonigricantis* Reimers 1951 in Südwestdeutschland. Bot. Jahrb. 78(4): 481-488. 1959.

NEWS AND NOTES

Leo F. Koch (429 Natural History Bldg., Univ. of Illinois, Urbana) is preparing a bibliography of bryology for the Scholar's Library Publishers. Authors of monographs or regional floristic and taxonomic papers are requested to forward the bibliographic information to Dr. Koch.

Dr. Josef Jedlička, lecturer (docent) in the faculty of arts of Masaryk's University, Brno, died suddenly on Dec. 7, 1959, at the age of 47.

The Montana State University Biological Station at Flathead Lake will offer a large variety of courses, all emphasizing field work June 13-Aug. 18. Wilfred B. Schofield will teach a 3-credit hour course in bryophytes. Address inquiries to the Montana State University Biological Station, Missoula, Mont.

A variety of biological courses will be offered at the Mountain Lake Biological Station of the University of Virginia, in two sessions, June 16-July 20 and July 21-Aug. 24, but bryology and lichenology are not included among them. Information is available from the Director, Mountain Lake Biological Station, University of Virginia, Charlottesville, Va.

The University of Michigan Biological Station will offer a program of teaching and research in bryology and lichenology under the direction of A. J. Sharp of the University of Tennessee, from June 18 to August 13 at Douglas Lake (near Pellston in northern Michigan). Five other courses on plants and eleven courses on animals, and their environments, and research on all the major environmental situations also will be conducted by a distinguished faculty. All of the work is centered on living plants and animals in their natural situations. The courses offer full college credit to both undergraduates and graduates. A limited number of grants-in-aid, made possible by The National Science Foundation and other sources, are available on a competitive basis. If interested, write to the University of Michigan Biological Station, 2129 Natural Science Building, Ann Arbor, Michigan.

Rudolf M. Schuster has received an Arctic Institute grant to take him to the Thule Eskimo village in Greenland for July and August of 1960.

As a reminder—the index to the first 60 volumes of *The Bryologist* is available at a cost of $5.00 from Dr. Lewis E. Anderson, Dept. of Botany, Duke University, Durham, N. C. Also, the first volume of *Index Muscorum* may be ordered from the International Bureau for Plant Taxonomy, Lange Nieuwstraat 106, Utrecht, Netherlands (free to regular institute members, $8.00 to associate institute members and regular personal members, and $15.00 to all others).

The society's annual meeting will be held in conjunction with the AIBS meetings at Stillwater, Okla. (Aug. 28-Sept. 1). The foray, led by Gilford J. Ikenberry, will be in southeastern Oklahoma, beginning on the evening of Aug. 25 at Beaver's Bend State Park. Aug. 26 will be spent there and in the Ouachita Mts. Aug. 27 will be spent partly in the Arbuckle Mts., with plans for arrival at Stillwater by dinnertime. Information is available from Mrs. Noe Higinbotham, Dept. of Botany, Washington State University, Pullman, Wash.

A 3-credit course in bryophytes at the graduate level will be presented at the University of Colorado, Boulder, in the second five-week session from July 33 to August 24 by DR. JANE TAYLOR. For information, write Dean of the Summer Session, University of Colorado, Boulder, Colo.

ELVA LAWTON retired last year from Hunter College and has settled in Seattle to devote her time to research and herbarium work at the University of Washington. She will teach a course in bryophytes there next fall.

The "Collegiate Rebel," a 124 ft. auxiliary schooner, sailed from Tampa Feb. 1 for a 2-yr. round-the-world cruise, through the Panama Canal to the Galápagos, Marquesas, Tahita, Raiatea, Tonga, Fiji, and Samoa. HENRY O. WHITTIER will collect bryophytes for H. A. MILLER, who will join him about June 1 at Colonia (Ponape, Caroline Islands) for three months in Micronesia, mostly in the Carolines, Palau, and Yap. They will fly back home about September 1.

RUDOLF M. SCHUSTER has laid plans for a leave of absence from January to June of next year when he will go to the University of Buenos Aires and do field work in Patagonia and the Cordillera of South America, thanks to the National Science Foundation.

WILLIAM C. STEERE plans a trip to northern Alaska this summer with OLLE MÅRTENSSON of Sweden and KJELD HOLMEN of Denmark, with the hope of spotting unsuspected differences in the field between the Alaskan arctic bryophytes and those of Greenland and Arctic Scandinavia. The excursion will be supported by the Arctic Institute of North America.

In connection with his work on a monograph of *Parmelia* in the Western Hemisphere, supported by a NSF grant, MASON HALE spent five weeks collecting cryptogams in southern Mexico this spring.

RUTH D. SVIHLA departed from Seattle April 8 for a year or more in Burma, where her husband will teach at Mandalay College.

CHARLES D. BIRD has received a Canadian National Research Council post-doctoral fellowship for a year of study on the mosses of the prairies and adjoining parklands of Alberta, Saskatchewan, and Manitoba (beginning June 1). The fellowship will be administered by the University of Alberta.

GILFORD J. IKENBERRY will retire this year after 22 years of service at Oklahoma State University.

Travelers to Alaska may be able to help T. C. FRYE (University of Washington, Seattle) who would like material of *Frullania chilcootiensis*. This species, known only from the original collection from the Chilkoot Pass area (on the old gold rush route from SE. Alaska to the Yukon) is not well understood.

HARLEY H. BARTLETT, professor emeritus and formerly head of the department of botany and of the botanical gardens at the University of Michigan, died in Ann Arbor on Feb. 21, at the age of 73. Prof. Bartlett was interested in *Sphagnum* early in his career and supplied Warnstorf with a quantity of material. He also made important collections of bryophytes in the Philippines, Mexico, Haiti, Panama, and many other parts of the world.

A summary of nomenclatural decisions at the Montreal congress, as they affect bryophytes, appeared in Revue Bryologique 28(3/4), p. 411.

RONALD L. MCGREGOR, who had planned to spend the spring semester

collecting Riccias in Mexico and southeastern U.S. has had to postpone his trip until January of next year.

FRED HERMANN plans to visit northern Michigan, including Isle Royale, in August. From May 15 to July 15, he is making a truly grand tour of European herbaria to study types of *Glycine* (Leguminosae).

After a year of study on Massachusetts mosses at Harvard, FRANK HILFERTY sailed May 16 for about three months in Europe.

HENRY T. DARLINGTON writes that his *Guide to the Mosses of Michigan* was delivered to the Michigan State University Press last Oct. 29, and the illustrations early in January of this year. Besides keys to genera about 390 species and drawings of 121 species the work will include a history of bryology in the state and a glossary. IRMA SCHNOOBERGER contributed the portion on *Sphagnum*.

An index to numbers 1-20 of *The Journal of the Hattori Botanical Laboratory* is in preparation.

Hikobia, a journal devoted to the flora and vegetation of Japan (mainly the mosses, hepatics, and other lower plants), now in its second volume, is available from the editor, Dr. Yoshiwo Horikawa (Botanical Institute, Hiroshima University, Higashisenda, Hiroshima, Japan), at a cost of $2.50 a year, plus postage. The journal is issued twice a year. Volume 2, no. 1, consisted of 68 pages in English and Japanese.

ERRATA: In Dr. Conard's article on *Amblystegium*, vol. 62, p. 96, last line read στηγη, p. 97, line 1, read Dixon (1924) cited στεγεον, a roof, lid, as a root of *Amblystegium*.

Volume 62, Number 4 (pp. 215-278), was issued March 30, 1960

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Available from the Division of Forestry, Indiana Dept. of Conservation, Indianapolis 9.

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THE HEPATIC EXCHANGE

Beginning January 1, 1939, this Exchange has been operated under the same rules as The Moss Exchange. Privileges are available only to members of the American Bryological Society who have paid annual dues of 25c to MR. HARRY WILLIAMS, Millbrook, Ont., Canada. Only fully determined specimens in packets with complete data will be accepted. It is suggested that there be at least five packets of each species with an extra which will be forwarded to the Curator of Hepatics for the American Bryological Society Hepatic Herbarium. All material for determination should be sent to the Curator of Hepatics, DR. MARGARET FULFORD, Department of Botany, University of Cincinnati, Cincinnati, Ohio.

THE MOSS EXCHANGE

As announced in THE BRYOLOGIST **38**: 100, Sept.-Oct., 1935, there is now an exchange for mosses. This exchange is available to members of the American Bryological Society upon payment of annual dues of 25c to DR. E. H. KETCHLEDGE, Dept of Forest Botany, State College of Forestry, Syracuse 10, New York. Only fully identified specimens in packets with complete data on them should be sent in. It is suggested that there be five or more packets of each species.

These two exchanges offer an excellent opportunity for A.B.S. members to build up their own herbaria of choice, well-labelled specimens.